Maintenance Manual

14221-1200-5000

Rev. B, September 2020

UNITY® XG-100M

Front and Remote-Mount Mobile Radios

L3HARRIS™
FAST. FORWARD.

MANUAL REVISION HISTORY

REV.	DATE	REASON FOR CHANGE
–	Sep/11	Initial release.
A	Dec/13	Revised Specifications, Related Publications, Catalog and Part Numbers, Radio Programming, and Service Information sections. Added XGP, HHC-731 Hand-Held Controller, and Optional Cables section.
B	Sep/20	Added Service Parts, Assembly Diagram, XLP, RPM2, incorporated addendums, and updated Section 11.3. Rebranded for L3Harris.

L3Harris Technologies, Public Safety and Professional Communications (PSPC) Business, continually evaluates its technical publications for completeness, technical accuracy, and organization. You can assist in this process by submitting your comments and suggestions to the following:

L3Harris Technologies, Inc.
PSPC Business
Technical Publications
221 Jefferson Ridge Parkway
Lynchburg, VA 24501

fax your comments to: 1-434-455-6851
or
e-mail us at: PSPC_TechPubs@l3harris.com

CREDITS

Harris, Unity and EDACS are registered trademarks and ProVoice and TECHNOLOGY TO CONNECT, INFORM AND PROTECT are trademarks of L3Harris Technologies.

AMBE is a registered trademark and IMBE, AMBE+, and AMBE+2 are trademarks of Digital Voice Systems, Inc. Bird is a registered trademark of Bird Electronic Corporation. Bluetooth is a registered trademark of Bluetooth SIG, Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. SmartSiren is a registered trademark of Federal Signal Corporation.

All other brand and product names are trademarks, registered trademarks, or service marks of their respective holders.

NOTICE!

The material contained herein is subject to U.S. export approval. No export or re-export is permitted without written approval from the U.S. Government. Rated: EAR99 in accordance with U.S. Dept. of Commerce regulations 15CFR774, Export Administration Regulations.

Information and descriptions contained herein are the property of L3Harris Technologies. Such information and descriptions may not be copied or reproduced by any means or disseminated or distributed without the express prior written permission of L3Harris Technologies, PSPC Business, 221 Jefferson Ridge Parkway, Lynchburg, VA 24501.

The voice coding technology embodied in this product is protected by intellectual property rights including patent rights, copyrights, and trade secrets of Digital Voice Systems, Inc. The user of this technology is explicitly prohibited from attempting to decompile, reverse engineer, or disassemble the Object Code, or in any other way convert the Object Code into human-readable form.

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations, or substitutions of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

This product conforms to the European Union WEEE Directive 2012/19/EU. Do not dispose of this product in a public landfill. Take it to a recycling center at the end of its life.

L3Harris products comply with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive.

This manual is published by **L3Harris Technologies** without any warranty. Improvements and changes to this manual necessitated by typographical errors, inaccuracies of current information, or improvements to programs and/or equipment, may be made by **L3Harris Technologies** at any time and without notice. Such changes will be incorporated into new editions of this manual. No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose, without the express written permission of **L3Harris Technologies**.

Copyright© 2011, 2013, 2020, L3Harris Technologies.

TABLE OF CONTENTS

Section *Page*

1. SAFETY SYMBOL CONVENTIONS....7

2. OPERATIONAL SAFETY RECOMMENDATIONS....8
2.1 TRANSMITTER HAZARDS....8
2.2 SAFE DRIVING RECOMMENDATIONS....8
2.3 OPERATING RULES AND REGULATIONS....9
2.4 OPERATING TIPS....9

3. SPECIFICATIONS....10
3.1 GENERAL....10
3.2 TRANSCEIVER....11
3.2.1 General....11
3.2.2 Transmitter....11
3.2.3 Receiver....12
3.2.4 Audio....12
3.2.5 Global Positioning System (GPS)....13
3.3 REGULATORY....14
3.3.1 General....14
3.3.2 FCC Part 15 Statement....14
3.3.3 Industry Canada Statement....14

4. INTRODUCTION....15
4.1 GENERAL INFORMATION....15
4.2 CAPABILITIES AND FEATURES....19

5. RELATED PUBLICATIONS....24

6. REPLACEMENT PARTS....25

7. TECHNICAL ASSISTANCE....28

8. CATALOG AND PART NUMBERS....29
8.1 RADIOS AND CONTROL HEADS....29
8.2 FEATURE PACKAGES....29
8.3 RADIO PROGRAMMING....30
8.4 RADIO AND CONTROL HEAD FIRMWARE....31
8.5 INSTALLATION-RELATED COMPONENTS....32

9. OPERATING INFORMATION....32

10. PROGRAMMING THE RADIO....33
10.1 GENERAL INFORMATION....33
10.2 ESTABLISHING A PROGRAMMING LINK....34
10.2.1 Establishing an RS-232C Connection with a Radio....34
10.2.2 Establishing a USB Connection with the XG-100M and CH-100....35
10.2.3 Establishing a Bluetooth Wireless Link with the XG-100M and CH-100....35
10.3 FLASH PROGRAMMING RADIO FIRMWARE....37
10.3.1 Obtaining a Radio's Current Firmware Codes' Versions....37
10.3.2 Flashing the Radio via an RS-232C Serial Connection....38
10.3.3 Flash Programming a Radio via a USB or Bluetooth Connection....39
10.3.4 Flashing CH-100 Control Head Firmware....40
10.3.5 Flashing CH-721 Control Head Firmware....41

TABLE OF CONTENTS

Section — Page

10.4 RADIO PERSONALITY PROGRAMMING 42
10.4.1 Personality Programming via an RS-232C Serial Connection 42
10.4.2 Extracting (Reading) a Mission Plan from a Radio(s) 43
10.4.3 Programming (Writing) Personalities/Mission Plans to a Radio 45
10.4.4 Removing a Mission Plan via RPM (CH-100 Control Head Only) 46
10.4.5 Activating a Mission Plan via RPM (CH-100 Control Head Only) 46
10.5 ADDING SOFTWARE FEATURE PACKAGES TO THE RADIO 47
10.5.1 Displaying Currently Enabled Software Feature Packages 47
10.5.2 Enabling Software Feature Packages 47
10.6 ENCRYPTION KEYS 48
10.6.1 Key Management with the L3Harris Key Manger 48
10.6.2 Key Management with the Motorola KVL 3000 Plus Loader 52
10.6.3 Zeroing Keys 54

11. SERVICE INFORMATION 56
11.1 GENERAL INFORMATION 56
11.2 GENERAL GUIDELINES ON CARING FOR THE RADIO EQUIPMENT 56
11.3 PREVENTIVE MAINTENANCE 56
11.3.1 General Preventive Maintenance 56
11.3.2 Maintenance Schedule of Basic Radio Measurements 57
11.4 RF PERFORMANCE TESTS 58
11.4.1 General Information 58
11.4.2 Minimum Qualifications of the Service Technician 58
11.4.3 Test Equipment 59
11.4.4 Recommended Conventional Test Personality/Mission Plan 60
11.4.5 Bench Setup 62
11.4.6 Synthesizer Performance Test 64
11.4.7 Transmitter Performance Tests 64
11.4.8 Receiver Performance Tests 78
11.5 DISPLAYED ERROR MESSAGES (WITH CH-100 CONTROL HEAD) 86
11.6 RADIO CONNECTOR PIN-OUTS 88
11.6.1 9-Pin I/O Connector on Rear Panel (TIA/EIA/RS-232C Serial Port) 88
11.6.2 44-Pin I/O Connector on Rear Panel (for Optional/Accessory Connections) 89

12. OPTIONAL CABLES 93
12.1 OPTION CABLE 14002-0174-01 (FORMERLY CA-012349-001) 93
12.2 CONTROL HEAD OPTION CABLE CA-011854-001 95
12.3 ACCESSORY CABLE 19B802554P24 96
12.4 HHC-731 INTERFACE CABLE CA-018399-001 97
12.5 SERIAL DATA CABLE CA-013671-020 98
12.6 CH-721 SERIAL PROGRAMMING CABLE CA-104861 98
12.7 CH-721 MIC CONNECTOR PROGRAMMING CABLE CA-103541-001 99
12.8 SPEAKER-ONLY OPTION CABLE 14002-0174-07 (FORMERLY CA-012349-007) 99

13. TROUBLESHOOTING 101
13.1 GENERAL 101
13.2 STATUS AND ERROR CODES DISPLAYED AT CONTROL HEAD 102

14. ASSEMBLY DIAGRAMS 109

LIST OF TABLES

Page

Table 6-1: Replacement Parts 25
Table 8-1: Unity XG-100M and CH-100/CH-721 Part Numbers 29
Table 8-2: Unity XG-100M Feature Packages 29
Table 8-3: Unity Radio Programming Software and Cable 30
Table 8-4: Radio Firmware (Non-XGP) - Contents of Distribution Kit ST-018940-001 31
Table 8-5: Radio Firmware (XGP) - Contents of Distribution Kit 14005-0132-01 31
Table 8-6: Radio Firmware (XLP) - Contents of Distribution Kit 14005-0229-01 31
Table 8-7: Radio Burn and Boot Applications (Normally Distributed via Tech-Link or Software Services) 31
Table 8-8: CH-100 Firmware (Non-XGP) - Contents of Distribution Kit 14005-0033-01 31
Table 8-9: CH-100 Firmware, XGP - Contents of Distribution Kit 14005-0134-01 32
Table 8-10: CH-100 Firmware (XLP) - Contents of Distribution Kit 14005-0230-01 32
Table 8-11: CH-721 Firmware - Contents of Distribution Kit ST-011241-001 32
Table 11-1: Maintenance Schedule of Basic Radio Measurements 57
Table 11-2: Test Equipment for Tests and Alignments 59
Table 11-3: Analog Conventional and P25 Conventional Test Channels for Test Personality/Test Mission Plan 61
Table 11-4: Synthesizer Performance Test Results 64
Table 11-5: Maximum Transmit Frequency Errors for Recommended Test Channels 66
Table 11-6: Measured Transmit Frequencies for Recommended Test Channels, and Test Results 67
Table 11-7: Transmitter Power Test—Maximum Errors, and Test Results 70
Table 11-8: Transmit 60% System Deviations and Maximum Deviations 72
Table 11-9: Transmitter Analog Modulation Tests Results 74
Table 11-10: Transmit CTCSS/CDCSS and Composite Deviations 74
Table 11-11: Transmitter CTCSS/CDCSS Modulation and Composite Deviation Tests Results 75
Table 11-12: Transmitter P25 (C4FM) Modulation Pattern Test with CH-100 Control Head Test Results 77
Table 11-13: Transmitter P25 (C4FM) Modulation Pattern Test with CH-721 Control Head Test Results 78
Table 11-14: Rx Audio Output Level, Distortion Level, and Speaker Tests Results 79
Table 11-15: Rx 12 dB SINAD Sensitivity Test Results 81
Table 11-16: Rx Noise Squelch Test Results 82
Table 11-17: Receiver CTCSS/CDCSS Decode Test Results 83
Table 11-18: Rx P25 Sensitivity (BER) with CH-100 Control Head Test Results 85
Table 11-19: Rx P25 Sensitivity (BER) with CH-721 Control Head Test Results 86
Table 11-20: Displayed Error Messages, Reasons, and Resolutions 86
Table 11-21: 9-Pin I/O Connector Pin-Out 88
Table 11-22: Radio's 44-Pin Connector Pin-Out and Option Cable 14002-0174-01 Interconnections 89
Table 13-1: General Troubleshooting 101
Table 13-2: Error Codes 102

LIST OF FIGURES

Page

Figure 4-1: Front-Mount Unity XG-100M Mobile Radio with CH-100 Control Head 16
Figure 4-2: Unity XG-100M Front-Mount and Remote-Mount Mobile Radios Front and Rear Views 17
Figure 4-3: CH-100 Control Head - Front View 21
Figure 4-4: CH-100 Control Head - Rear View 21
Figure 4-5: CH-721 Scan Model Control Head Front Panel 22
Figure 4-6: CH-721 System Model Control Head Front Panel 22
Figure 4-7: CH-721 Rear Panel (Both Control Head Models) 22
Figure 4-8: HHC-731 Hand-Held Controller Front View 23
Figure 10-1: Cable Connections for Radio Programming via an RS-232C Serial Cable Link 34
Figure 10-2: RPM's Program and Program with Override Buttons (Example Main Dialog Box) 42
Figure 10-3: RPM's Override Options Dialog Box (with Example LID Numbers) 43
Figure 10-4: Unity Product Management Dialog Box (Example with no Radios Connected) 44
Figure 10-5: Unity Product Management Dialog Box (Example with two Radios Connected) 44
Figure 11-1: XG-100M Tx Power Levels Dialog Box with Required Settings 62
Figure 11-2: High and Low Transmit Power Level Icons 69
Figure 12-1: Option Cable 14002-0174-01 93
Figure 12-2: Control Head Option Cable CA-011854-001 95
Figure 12-3: Accessory Cable 19B802554P24 96
Figure 12-4: HHC-731 Interface Cable CA-018399-001 97
Figure 12-5: Serial Data Cable CA-013671-020 98
Figure 12-6: CH-721 Serial Programming Cable CA-104861 99
Figure 12-7: CH-721 Serial Programming Cable CA-103541-001 99
Figure 12-8: Speaker-Only Option Cable 14002-0174-07 100

1. SAFETY SYMBOL CONVENTIONS

The following conventions are used in this manual to alert the user to general safety precautions that must be observed during all phases of operation, installation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere violates safety standards of design, manufacture, and intended use of the product. L3Harris assumes no liability for the customer's failure to comply with these standards.

WARNING

The WARNING symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING symbol until the conditions identified are fully understood or met.

CAUTION

The **CAUTION** symbol calls attention to an operating procedure, practice, or the like, which, if not performed correctly or adhered to, could result in damage to the equipment or severely degrade equipment performance.

NOTE

The **NOTE** symbol calls attention to supplemental information, which may improve system performance or clarify a process or procedure.

The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of **E**lectro-**S**tatic **D**ischarge. Proper precautions must be taken to prevent ESD when handling circuit boards or modules.

2. OPERATIONAL SAFETY RECOMMENDATIONS

2.1 TRANSMITTER HAZARDS

WARNING

The operator of any mobile radio should be aware of certain hazards common to the operation of vehicular radio transmissions. Possible hazards include but are not limited to:

- **Explosive Atmospheres** — Just as it is dangerous to fuel a vehicle while its engine is running, be sure to turn the radio **OFF** while fueling the vehicle. If the radio is mounted in the trunk of the vehicle, **DO NOT** carry containers of fuel in the trunk.

  Areas with potentially explosive atmosphere are often, but not always, clearly marked. Turn the radio OFF when in any area with a potentially explosive atmosphere. It is rare, but not impossible, that the radio or its accessories could generate sparks.
- **Interference to Vehicular Electronic Systems** — Electronic fuel injection systems, electronic anti-skid braking systems, electronic cruise control systems, etc., are typical of the types of electronic devices that can malfunction due to the lack of protection from radio frequency (RF) energy present when transmitting. If the vehicle contains such equipment, consult the dealer for the make of vehicle and enlist his aid in determining if such electronic circuits perform normally when the radio is transmitting.
- **Electric Blasting Caps** — To prevent accidental detonation of electric blasting caps, **DO NOT** use two-way radios within 1000 feet (305 meters) of blasting operations. Always obey the "**Turn Off Two-Way Radios**" (or equivalent) signs posted where electric blasting caps are being used. (OSHA Standard: 1926.900).
- **Radio Frequency Energy** — To prevent burns or related physical injury from radio frequency energy, do not operate the transmitter when anyone outside of the vehicle is within the minimum safe distance from the antenna as specified in the respective radio's *Product Safety Manual*.
- **Vehicles Powered by Liquefied Petroleum (LP) Gas** — Radio installation in vehicles powered by liquefied petroleum gas, where the LP gas container is in the trunk or other sealed-off space within the interior of the vehicle, must conform to the **N**ational **F**ire **P**rotection **A**ssociation standard **NFPA 58**. This requires:
  - The space containing the radio equipment must be isolated by a seal from the space containing the LP gas container and its fittings.
  - Outside filling connections must be used for the LP gas container.
  - The LP gas container space shall be vented to the outside of the vehicle.

2.2 SAFE DRIVING RECOMMENDATIONS

The American Automobile Association (AAA) advocates the following key safe driving recommendations:

- Read the literature on the safe operation of the radio.
- Keep both hands on the steering wheel and the microphone in its hanger whenever the vehicle is in motion.
- Place calls only when the vehicle is stopped.
- When talking from a moving vehicle is unavoidable, drive in the slower lane. Keep conversations brief.

- If a conversation requires taking notes or complex thought, stop the vehicle in a safe place and continue the call.
- Whenever using a mobile radio, exercise caution.

2.3 OPERATING RULES AND REGULATIONS

Two-way radio systems must be operated in accordance with the rules and regulations of the local, regional, or national government.

In the United States, this mobile radio must be operated in accordance with the rules and regulations of the Federal Communications Commission (FCC). Operators of two-way radio equipment must be thoroughly familiar with the rules that apply to the radio operation. Following these rules helps eliminate confusion, assures the most efficient use of the existing radio channels, and results in a smoothly functioning radio network.

When using a two-way radio, remember these rules:

- It is a violation of FCC rules to interrupt any distress or emergency message. The radio operates in much the same way as a telephone "party line." Therefore, always listen to make sure the channel is clear before transmitting. Emergency calls have priority over all other messages. If someone is sending an emergency message – such as reporting a fire or asking for help in an accident, do not transmit unless assistance can be offered.
- The use of profane or obscene language is prohibited by Federal law.
- It is against the law to send false call letters or false distress or emergency messages. The FCC requires keeping conversations brief and confined to business. Use coded messages whenever possible to save time.
- Using the radio to send personal messages (except in an emergency) is a violation of FCC rules. Send only essential messages.
- It is against Federal law to repeat or otherwise make known anything overheard on the radio. Conversations between others sharing the channel must be regarded as confidential.
- The FCC requires self-identification at certain specific times by means of call letters. Refer to the rules that apply to the operation for the proper procedure.
- No changes or adjustments shall be made to the equipment except by an authorized or certified electronics technician.

CAUTION

Under U.S. law, operation of an unlicensed radio transmitter within the jurisdiction of the United States may be punishable by a fine of up to $10,000, imprisonment for up to two (2) years, or both.

2.4 OPERATING TIPS

The following conditions tend to reduce the effective range of two-way radios and should be avoided whenever possible:

- Operating the radio in areas of low terrain, or while under power lines or bridges.
- Obstructions such as mountains and buildings.

NOTE

In areas where transmission or reception is poor, communication improvement may sometimes be obtained by moving a few yards in another direction or moving to a higher elevation.

3. SPECIFICATIONS[1]

3.1 GENERAL

Dimensions, Height x Width x Depth (See footnote [2])

Front-Mount Radio with CH-100:	3.3 x 7.0 x 11.6 inches (8.4 x 17.8 x 29.5 centimeters)
Front-Mount Radio with CH-721:	2.4 x 6.9 x 11.3 inches (6.1 x 17.5 x 28.7 centimeters)
Remote-Mount Radio:	2.0 x 6.9 x 9.7 inches (5.1 x 17.5 x 24.7 centimeters)
CH-100 Control Head (Remote-Mount):	3.3 x 7.0 x 2.8 inches (8.4 x 17.8 x 7.1 centimeters)
CH-721 Control Head (Remote-Mount):	2.4 x 6.9 x 3.9 inches (6 x 17.5 x 10 centimeters)
HHC-731 Hand-Held Controller:	5.3 x 2.8 x 1.3 inches (13.46 x 7.11 x 3.30 centimeters) (Does not include swivel hanger and coiled cord)

Weight (See footnote [3])

Front-Mount Radio with CH-100:	6.45 pounds (2.93 kilograms)
Front-Mount Radio with CH-721:	5.9 pounds (2.68 kilograms)
CH-100 Control Head (Remote-Mount):	1.20 pounds (0.54 kilograms)
CH-721 Control Head (Remote-Mount):	1.25 pounds (0.57 kilograms)
Remote-Mount Radio:	5.25 pounds (2.38 kilograms)
Control Head Mount Bracket:	0.4 pounds (0.18 kilograms)
HHC-731 Hand-Held Controller:	1.0 pound (0.45 kilograms), does not include bracket and interface cable to radio

Operating Ambient Temperature Range: -22 to +140° Fahrenheit (-30 to +60° Celsius)

Maximum Altitude

Operating:	15,000 feet (4,572 meters)
In Transit:	40,000 feet (12,192 meters)

DC Supply Voltage Operating Ranges

For Full Performance:	+13.6 Vdc ±10% (Normal range per TIA-603)
Overall Operating Range:	+10.8 to +16.6 Vdc
Continuous without Damage:	0 to +17 Vdc

DC Supply Current Requirements

Receive (includes control head)

With 15-Watt Speaker Output Power:	4.0 amps maximum

Transmit (includes control head):

At 35 Watts RF:	15 amps maximum, 12 amps typical
At 50 Watts RF (VHF and UHF Bands):	20 amps maximum, 15 amps typical

HHC-731 Hand-Held Controller:	0.5 amps maximum

Quiescent/Off Currents

Mobile Radio Only:	2 milliamps maximum
CH-100 Control Head Only:	100 microamps maximum
CH-721 Control Head Only:	100 microamps maximum

[1] These specifications are primarily intended for the use of the installation technician. See the appropriate Specifications Sheet for the complete specifications.
[2] Dimensions do not space required for mounting brackets, cables, clearance/access, etc.
[3] Weights do not include respective mounting brackets, cables, etc.

HHC-731 Hand-Held Controller:	500 microamps maximum

3.2 TRANSCEIVER

3.2.1 General

Frequency Ranges

VHF Low Band:	30 to 50 MHz (Receive Only)
VHF High Band:	136 to 174 MHz [See footnote [4]]
UHF Bands:	380 to 520 MHz [See footnotes 4 and [5]]
700 MHz Band:	762 to 806 MHz [See footnote [6]]
800 MHz Band:	806 to 870 MHz

Frequency Stability:	±0.5 ppm from -30 to +60° Celsius
Channel Spacing (Bandwidth):	12.5 kHz or 25 kHz (mode-dependent; see footnote 4)
Channel Tuning Increment:	2.5 kHz, 3.125 kHz, or 12.5 kHz (band-dependent)
Channel Capacity:	12,500 (1,250 per mission plan)

Mission Plans/Personalities:

With CH-100 Control Head:	10 maximum (1 active at a time)
With CH-721 Control Head:	1 maximum (always active)

Zones/Systems per Mission Plan:	512 maximum
Voice and Data Communications Modes:	Half-Duplex

3.2.2 Transmitter

Power Ranges

VHF High Band:	5 to 50 watts
UHF Band:	5 to 50 watts
700 Band:	2 to 30 watts
800 Band:	2 to 35 watts

Spurious and Harmonics:	-70 dBc

FM Hum and Noise

12.5 kHz Channel:	-34 dB (see footnote 4)
25 kHz Channel:	-40 dB (see footnote 4)

Frequency Modulation (FM) Limiting

Wideband Channels (25 kHz)	5 kHz (see footnote 4)
NSPAC Channels	4 kHz (see footnote 4)
Narrowband Channels (12.5 kHz)	2.5 kHz (see footnote 4)

P25 Modulation Fidelity:	< 1%
P25 Adjacent Channel Power:	> 67 dBc

[4] The Unity XG-100M mobile radio is compliant with all applicable FCC narrowbanding mandates below 512 MHz.

[5] Per FCC regulations, the lowest allowed UHF band transmit frequency for LMR operations is 406.1 MHz.

[6] 700 MHz mobile receive band is 764 to 767 MHz and 769 to 776 MHz.
700 MHz mobile transmit band is 764 to 767 MHz, 769 to 776 MHz, 794 to 797 MHz, and 799 to 806 MHz.

Audio Distortion: < 1.25%

3.2.3 Receiver

Sensitivity at 12 dB SINAD -119 dBm minimum (all bands)

Sensitivity at 5% BER -119 dBm minimum (all bands)

Signal Displacement Bandwidth 2 kHz typical, 5 kHz maximum for a wideband (25 kHz) channel

Adjacent Channel Rejection

Analog Channel at 12.5 kHz:	70 dB
Analog Channel at 25 kHz:	80 dB
Digital Channel at 12.5 kHz:	60 dB

Intermodulation Rejection: 72.5 dB minimum

Spurious and Image Rejection: 80 dB minimum

FM Hum and Noise

VHF Band:	-51 dB at 12.5 kHz; -53 at 25 kHz
UHF Bands:	-41 dB at 12.5 kHz; -47 at 25 kHz
700 and 800 MHz Bands:	-41 dB at 12.5 kHz; -47 at 25 kHz

Typical Analog Squelch Threshold: -124 dBm with 1 kHz tone at 3 kHz deviation

3.2.4 Audio

Audio Frequency Response: +1 to -3 dB from 300 to 3000 Hz (transmit and receive)

Microphone Input Sensitivity: 82 ±28 mV rms (typical)

Microphone Maximum Input Level: 2500 mV peak-to-peak

Microphone Input Impedance: 600 ohms

Microphone Connector: 17-pin Conxall-style flush-mount thumbscrew-locking connector located on front panel of control head

Microphone Types Available: Standard, DTMF, and Noise-Canceling

Speaker Audio Output Power: 15 watts RMS minimum into 4-ohm external speaker

Speaker Audio Output Distortion

CH-100 Control Head:	< 3% at 15 watts RMS into 4-ohm external load
CH-721 Control Head:	< 5% at 15 watts RMS into 4-ohm external load

Headset Audio Output Power

At CH-100 Microphone Connector:	0.5 watts minimum into 4-ohm headset/speaker
At CH-100 DB-25 Rear Panel Connector:	35 milliwatts maximum into 24-ohm headset
At CH-721 Microphone Connector:	0.5 watts minimum into 4-ohm headset/speaker
At CH-721 DB-25 Rear Panel Connector:	35 milliwatts maximum into 24-ohm headset
At HHC-731 DB-25 Connector:	1 watt minimum into 8-ohm headset/speaker

External Speaker Connection

Local Control (Front-Mount Radio):	2-pin audio connector on radio's option cable
Remote Control (Remote-Mount Radio):	2-pin audio connector on rear of control head
Remote Control with HHC-731:	DB-44 connector on rear of radio

Mic A-D and Speaker D-A Audio Conversion

CODEC Audio Sampling Rate:	8 kHz
CODEC Algorithm (Vocoding Method):	Sigma-Delta ($\Sigma\Delta$)

Voice-Coding Method

P25 Phase 1 Mode:	Advanced Multi-Band Excitation Plus (AMBE+)

Data Rate

P25 Mode:	4800 symbols/second

3.2.5 Global Positioning System (GPS)

Receive Frequency:	1.57542 GHz
Channels:	20
Tracking Sensitivity:	-159 dBm
Mode of Operation:	Non-Assisted GPS

Time-To-First-Fix (TTFF) Performance

From Cold Start (at -125 dBm; 90%):	≤ 38 seconds
From Hot Start (at -125 dBm; 90%):	≤ 1 second
Reacquisition (at -125 dBm; 90%):	≤1 second with ≤ 10-second obstruction

Horizontal Accuracy after TTFF (95%):	< 5.5 meters

Antenna

Required Type:	Externally Mounted Active (i.e., with internal RF amplifier)
Radio Connection:	SMA Connector on Radio's Rear Panel
Radio-Supplied DC Bias Power:	5 volts; 15 to 32 mA typical, 50 mA maximum
Port Impedance:	50 ohms

3.3 REGULATORY

3.3.1 General

FCC Type Acceptance: AQZ-XG-100M00

Applicable FCC Rules: Part 15, Part 80, and Part 90

Industry Canada Certification: 122D-XG100M00

Applicable Industry Canada Rules: RSS-119 Issue 10 and RS-210 Issue 8

3.3.2 FCC Part 15 Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

3.3.3 Industry Canada Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

4. INTRODUCTION

4.1 GENERAL INFORMATION

The Unity XG-100M mobile radio is a high-performance multiband mobile radio with advanced capabilities and unprecedented interoperability capability. The radio supports P25 trunked, P25 conventional, EDACS® trunked, and analog conventional operations. The radio is P25 Phase 2 capable. It covers the 136 to 174 MHz VHF band, the 380 to 520 MHz UHF bands, and the 762 to 870 MHz bands.

NOTE

EDACS trunked mode requires SK-018940-001 release R3 or later firmware. All versions of XGP and XLP software support EDACS. EDACS is only supported when the radio is used with a CH-721 control head or an HHC-731 hand-held controller.

The Unity XG-100M mobile radio and related equipment are designed to operate in a mobile environment, typically within a motor vehicle. The radio must be connected to an external vehicle-mounted transmit/receive antenna system approved for use with the radio. Several different types of antenna mounts and a multiband antenna element are approved and available for use with the radio. Refer to the radio's *Product Safety Manual*, publication number 14221-1200-4000, for additional information.

When operating on a VHF or UHF radio channel, the Unity XG-100M radio can provide 50 watts of transmit output power in full power transmit mode. The radio is rated at 30 watts in the 700 MHz RF band, and 35 watts in the 800 MHz RF band.

Front-mount and remote-mount radio configurations are available. In the front-mount configuration, the control head is an integral part of the mobile radio. In the remote-mount configuration, the control head is located near the radio operator's position and the radio is mounted remotely from the control head, typically in the vehicle's trunk or on an equipment shelf. Three (3) different control heads and a hand-held remote controller are available for use with the radio:

- **CH-100 Control Head** - Shown in Figure 4-1 in a front-mount radio configuration, the CH-100 features a 4.3-inch touchscreen sunlight-readable LCD color display, providing an easy-to-use menu-driven operator interface. This control head also features a Bluetooth® wireless interface for connection of optional equipment and to support radio and control head programming via a wireless connection. The front panel of the CH-100 control head also features an easy-to-use on/off/volume control and group/channel selection controls, an emergency button, a home button, a USB programming port, a transmit/receive busy indicator, and a microphone connector.
- **CH-721 Scan Model Control Head** - This control head features a large 3-line graphical vacuum-fluorescent display and easy-to-use front panel controls, including three (3) large menu-related buttons. Figure 4-5 on page 22 details all front panel components.
- **CH-721 System Model Control Head -** Figure 4-2 on page 17 illustrates the CH-721 System model control head in a front-mount configuration. This control head is very similar to the CH-721 Scan model control head. It has an identical 3-line graphical vacuum-fluorescent display. Also, front panel controls are identical to those on the Scan model control head except for the 12-key keypad and smaller menu-related buttons. The 12-key numeric keypad provides Dual-Tone Multi-Frequency (DTMF) functionality and advanced operator system/group selection control via the control head's front panel. Figure 4-6 on page 22 details all front panel components.

- **HHC-731 Hand-Held Controller** - The HHC-731 can be used in place of a control head in a remote-mount XG-100M mobile radio installation. This easy-to-use hand-held controller is primarily designed for use in harsh environments such as maritime (i.e., boating) applications and All-Terrain Vehicle (ATV) applications. The HHC-731 has easy-to-use buttons, a tough liquid-crystal display (LCD), and a built-in microphone. Only one (1) HHC-731 can be connected to a radio, and without any connected control heads. The front of the HHC-731 is shown in Figure 4-8 on page 23.

Figure 4-1: Front-Mount Unity XG-100M Mobile Radio with CH-100 Control Head

Figure 4-7 on page 22 illustrates the rear panel of the two CH-721 control heads. Both have identical rear panels and rear panel connectors.

All three (3) control heads feature a large easy-to-use volume/on/off rotary control and a rotary system/group/channel selection control. In addition, each head also has a front panel microphone connector, and an internal high-power audio amplifier to drive an externally connected speaker. All control heads used with remote-mount radios have rear panel connectors for DC power, CAN link, speaker audio output, serial port, and optional accessory connections.

In a remote-mount radio configuration, a Controller Area Network (CAN) cable provides the radio-to-control head connection. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio, controlling data such as button presses and radio messages, and user data such as that for a mobile data terminal connected to the serial port of the radio or control head. The CAN link is basically 2-wire (with shield ground) daisy-chained high-speed serial data link. For proper operation, the CAN link must be terminated on each end with a simple resistive-type terminator.

The CAN link is also used to interconnect additional control heads to a radio in a multi-control head installation. In a multi-control head installation, more than one control head is utilized with a radio. A multi-control head installation may be required in a vehicle such as a fire truck or any large vehicle where more than one operator position must support radio use. For example, a ladder fire truck can have a front-mount XG-100M mobile radio mounted under the truck's dash panel and a remote-mount control head mounted at the ladder operator's position. Each control head in a multi-control head installation is equipped with an external speaker, a microphone, and optionally connected equipment. Multi-control head installations provide other benefits such as intercom functionality. The XG-100M mobile radio can support up to six (6) control heads.

NOTE

Within a multi-control head radio installation, the CH-100 control head **cannot** be mixed with the CH-721 control head or the HCC-731 hand-held controller. For example, a remote-mount CH-721 cannot be connected to a front-mount XG-100M radio with a CH-100 control head.

Figure 4-2: Unity XG-100M Front-Mount and Remote-Mount Mobile Radios Front and Rear Views

The radio and control head must be powered by an external +13.6-volt (nominal) DC power source. In mobile applications, the motor vehicle's electrical system is utilized as the source of DC power. In a remote-mount radio installation, the control head(s) connected to the radio is also powered by the same DC power source, but separately fused. When the control head is powered-up by the operator, it "wakes up" the radio by transmitting data to the radio via the CAN link.

The radio provides half-duplex voice and data communications. Voice communications are accomplished via a "push-to-talk" (PTT) type microphone and an external speaker connected to the control head. When a control head is employed in a remote-mount mobile radio installation, an audio amplifier in the control head drives the speaker.

For data communications, the radio has an industry-standard TIA/EIA/RS-232C type 9-pin serial interface port for connecting optional data-type equipment, such as a Mobile Data Terminal (MDT), a laptop PC, an external display, or a key-entry device. This port works seamlessly with equipment from popular manufacturers and off-the-shelf applications. This port can also be used for radio program operations, and radio diagnostic functions.

The radio also has a built-in Global Positioning System (GPS) receiver. This receiver provides position and speed tracking and accurate time via the control head's display. It also provides GPS NMEA-formatted serial data to several pins on the radio's rear panel 44-pin connector. This is provided for external equipment running third-party GPS-related software. The GPS receiver's antenna can be integrated into the mobile transmit/receive antenna (i.e., a "combination" antenna). Alternately, the GPS antenna can be located/mounted separate from the mobile transmit/receive antenna. As of the publication of this manual, over-the-air GPS data messaging is not supported.

For over-the-air secure radio communications, the Unity XG-100M mobile radio may be optionally equipped for 256-Bit Advanced Encryption Standard (AES) voice encryption or 64-bit Digital Encryption Standard (DES) encryption. With encryption, voice and/or user data signals transmitted and received by the radio on an RF channel are digitally encrypted ("scrambled") to virtually eliminate unauthorized monitoring via the RF channel. DES encryption is offered in both standard Output Feedback (DES-OFB) and Cipher Feedback (DES-CFB) formats.

The Unity XG-100M mobile radio and its control heads exceed tough environmental specifications included within military standard MIL-STD-810F, the radio industry standard TIA/EIA-603, and the radio standard established by the U.S. Forest Service.

L3Harris recommends the buyer use only an authorized representative to install and service this product. The warranties provided to the buyer under the terms of sale shall be null and void if this product is installed or serviced improperly, and L3Harris shall have no further obligation to the buyer for any damage caused to the product or to any person or personal property.

4.2 CAPABILITIES AND FEATURES

Capabilities and features of the XG-100M mobile radio include but are not limited to:

- Full-Spectrum Multiband Radio:
  - VHF-high band with up to 50 watts of transmit power
  - UHF-low and UHF-high bands with up to 50 watts of transmit power
  - 700 MHz band with up to 30 watts of transmit power
  - 800 MHz band with up to 35 watts of transmit power
  - VHF-low band (receive-only as of the publication of this manual)
- APCO Project 25 Phase 1 compliant P25 trunked communication standard
- APCO Project 25 Phase 1 compliant P25 conventional communication standard
- APCO P25 Phase 2 compliant (XGP firmware required)
- Conventional FM repeater-based and FM talk-around voice communication in accordance with the TIA/EIA-603 conventional land-mobile radio standard (i.e., analog conventional channels)
- 256-Bit Advanced Encryption Standard (AES) voice encryption (optional)
- Digital Encryption Standard Output Feedback (DES-OFB) voice encryption (optional)
- Digital Encryption Standard Cipher Feedback (DES-CFB) voice encryption (optional)
- Over-The-Air Rekey (OTAR) operations on P25 trunked radio systems (optional)
- Global Common Key References (CKR)
- 128-key storage for encrypted voice communications
- Conventional voter scan
- Pre-emptive priority scan
- Radio with a CH-100 control head features L3Harris' proprietary background noise suppression technology in any communication mode
- Front- or remote-mount radio
- Meets tough U.S. military standard (MIL-STD-810G)
- Meets tough U.S. Forest Service vibration standard (USDA LMR Standard Section 2.15)
- Integrated Global Positioning System (GPS) receiver for position and speed tracking and accurate time
- CH-100 control head has a built-in Bluetooth wireless interface for wireless connection of optional accessories and programming equipment
- CH-100 control head has a Universal Serial Bus (USB) interface port to support USB-linked programming operations
- CH-100 control head features a 4.3-inch touchscreen transreflective color LCD display with white LED backlighting and intuitive, an easy-to-use navigational keypad with soft-keys, and user-friendly graphical user interface
- CH-721 control head features a large 3-line graphical vacuum-fluorescent display and easy-to-use front panel controls

- HHC-731 hand-held controller features include easy-to-use buttons, a tough liquid-crystal display (LCD), and a built-in microphone
- CH-100 control head features a dedicated emergency button
- CH-100 control head features a dedicated home button
- CH-721 control head features a dedicated emergency/home button (function programmable)
- HHC-731 hand-held controller features a dedicated emergency/home button (function programmable)
- Option connectors for connection of optional accessories
- Radio programming and feature management via L3Harris' Radio Personality Manager (RPM) or Radio Personality Manager 2 (RPM2) R3A or later
- Up to 10 personalities/mission plans (CH-100 control head only)
- Up to 512 zones/systems per personality/mission plan
- Up to 1250 conventional channels per conventional personality/mission plan
- Personality/Mission plan easily activated from front panel (CH-100 control head only)
- Zone/System easily activated from front panel
- Conventional channels' parameters such as transmit frequency, receive frequency, and signaling, are front-panel-programmable/editable with password-protection via an RPM-established password
- Quick mission plan change/activation via radio's front panel menu-driven interface
- Programmable wideband or narrowband operation on a per-channel or zone/system basis
- Programmable transmit power level on a per-channel or zone/system basis
- Quick channel edit capability via radio's front panel interface (password protectable)
- Continuous Tone-Code Squelch System (CTCSS or Channel Guard), Digital-Coded Squelch (DCS or Digital Channel Guard), and MDC-1200 analog ID signaling
- Scan with configurable Priority 1 and Priority 2 channels
- Preemptive priority scanning
- Continuously scan all RF bands

Figure 4-3: CH-100 Control Head - Front View

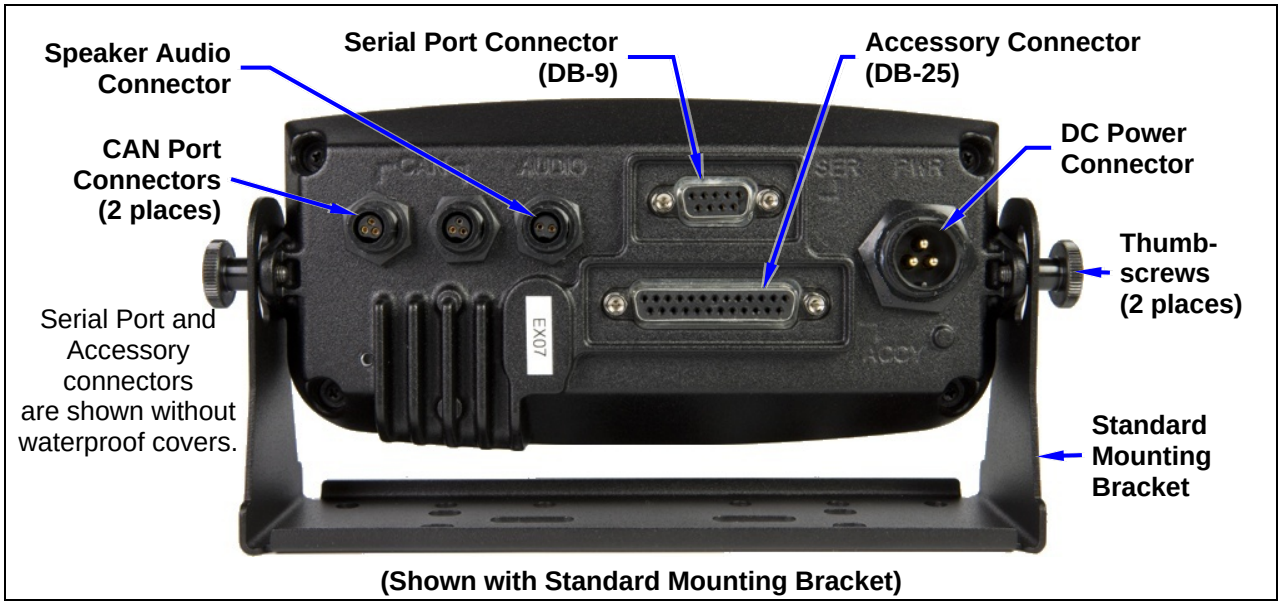


Figure 4-4: CH-100 Control Head - Rear View

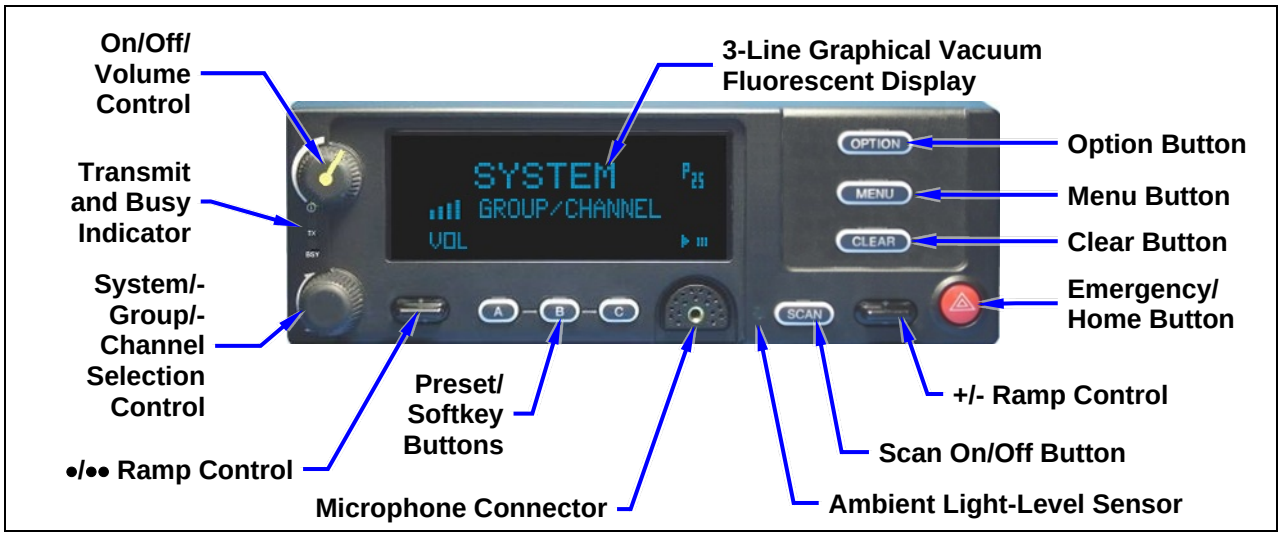
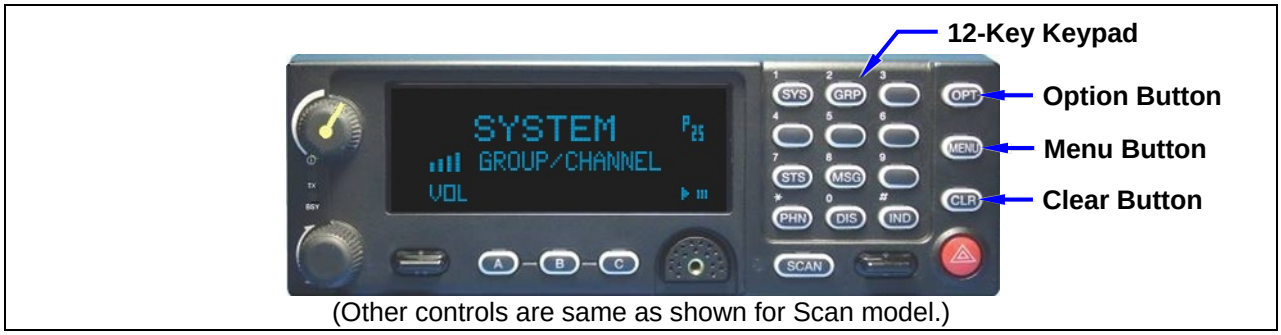


Figure 4-5: CH-721 Scan Model Control Head Front Panel



(Other controls are same as shown for Scan model.)

Figure 4-6: CH-721 System Model Control Head Front Panel

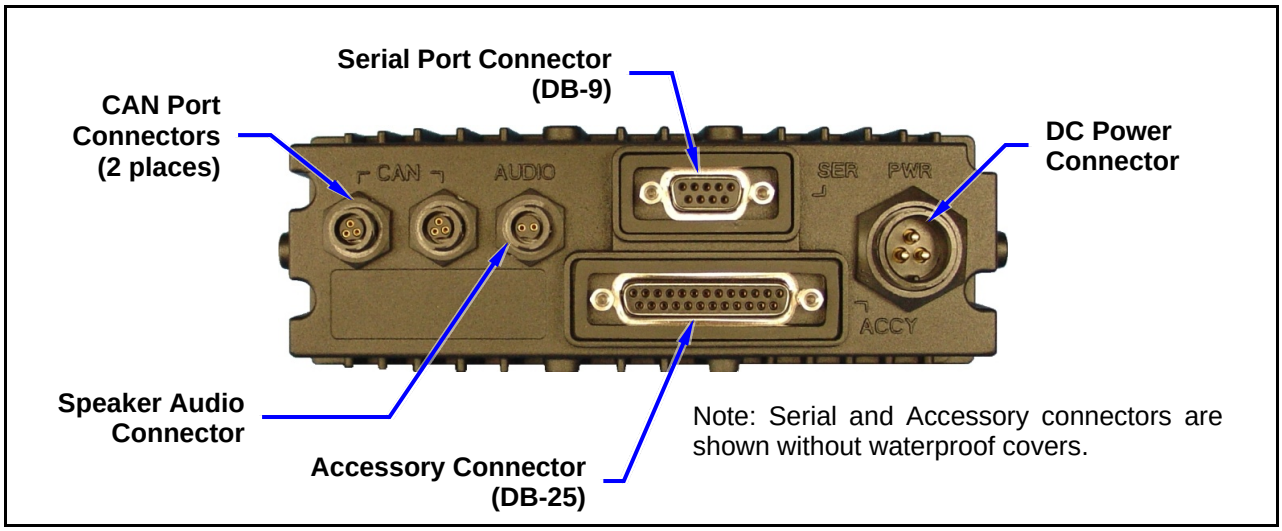


Figure 4-7: CH-721 Rear Panel (Both Control Head Models)

Figure 4-8: HHC-731 Hand-Held Controller Front View

5. RELATED PUBLICATIONS

The following publications contain additional information about the Unity XG-100M mobile radio and related software:

PUBLICATION NUMBER	DESCRIPTION
14221-1200-4000	Product Safety Manual
14221-1200-4440	Installation Manual
14221-1200-1010	Quick Guide for Unity XG-100M Mobile Radio with CH-100 Control Head
14221-1200-1000	Quick Guide for Unity XG-100M Mobile Radio with CH-721 Control Head
14221-1200-2010	Operator's Manual for Unity XG-100M Mobile Radio with CH-100 Control Head
14221-1200-2000	Operator's Manual for Unity XG-100M Mobile Radio with CH-721 Control Head
MM-018321-001	Operator's Manual for HHC-731 Hand-Held Controller
MM-008918-001	Maintenance Manual for CH-721 Control Head
MM-018323-001	Maintenance Manual for HHC-731 Hand-Held Controller
14221-1100-8140	XGP Software Release Notes
14221-1800-8000	XLP Software Release Notes
MS-012550-001	Radio Personality Manager (RPM) Software Release Notes
14221-1100-8170	Radio Personality Manager 2 (RPM2) Software Release Notes
14221-1100-2060	Radio Personality Manager 2 (RPM2) User's Manual
14221-1200-4030	CH-100 Conversion Kit Installation Manual

The *Product Safety Manual* and *Quick Guides* (for radio operators) are included with each mobile radio equipment package when the package ships from the factory. The *Operator's Manuals* and the *Quick Guides* are also available online at http://pspc.harris.com without a login. All XG-100M-related mobile radio publications can be obtained from www.pspc.harris.com via an Information Center login (a user name and password are required). The publications are in Tech-Link's Technical Manual Library.

6. REPLACEMENT PARTS

Replacement parts listed in Table 6-1 can be ordered via our Customer Care center. To order replacement parts, call, fax, or e-mail:

United States:

Phone Number: 1-800-368-3277

Fax Number: 1-321-409-4393

E-mail: PSPC_CustomerFocus@l3harris.com

International:

Phone Number: 1-434-455-6403

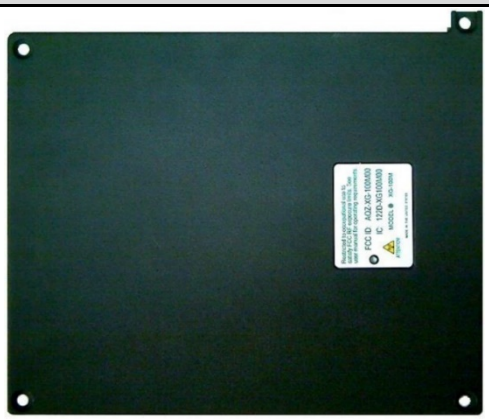
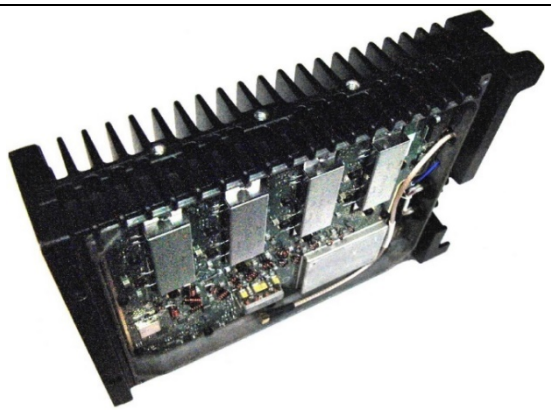
Fax Number: 1-321-409-4394

E-mail: PSPC_InternationalCustomerFocus@l3harris.com

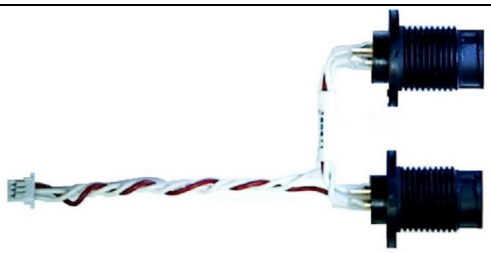
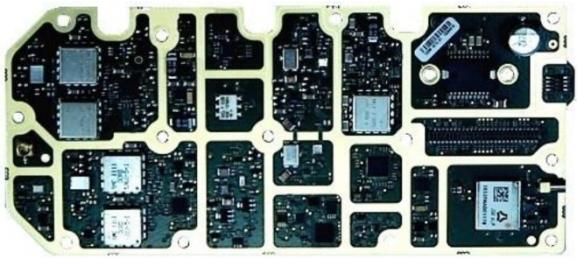
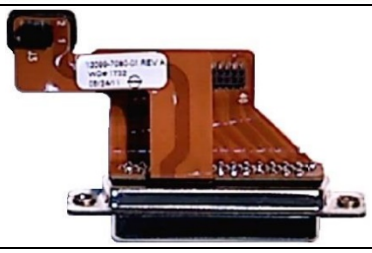
Refer to the assembly diagrams in Section 14 when installing any of the replacement parts in Table 6-1.

Table 6-1: Replacement Parts

PART NUMBER	DESCRIPTION	ILLUSTRATION
12099-7800-01	Gasket, D-Sub Connectors	
12099-7800-02	Cover, Front	
12099-7800-03	Cover, Top, Cast, Finish	

PART NUMBER	DESCRIPTION	ILLUSTRATION
12099-7800-04	Cover, Bottom, Cast, Finish	
12099-7800-05[7]	Heatsink Assembly, PA Prepped for Use	
12099-7800-06	Cable Assembly, Coaxial, High B	
12099-7800-07	Cable Assembly, Coax, LB Antenna	
12099-7800-08[7]	PWB Assembly, MB-LMR Digital	
12099-7800-09	FWB Assembly, 9-Pin D-Sub Connector	

[7] This part is not field-replaceable and must be returned to L3Harris for replacement.

PART NUMBER	DESCRIPTION	ILLUSTRATION
12099-7800-10	Cable Assembly, GPS Connector Coaxial	
12099-7800-11	Cable Assembly, CAN Connectors	
12099-7800-12	Cable Assembly, Connector Power Interface	
12099-7800-13	Seal, Rear, Transceiver	
12099-7800-14[8]	PWB Assembly, MB-LMR Mobile Res	
12099-7800-15	Cable Assembly, Connector Power	
12099-1203-01	Conversion Kit, CH-100, Front to Remote Contains: • Quantity = 1, 12099-1260-01, Cover Assembly, Rear, Control Head • Quantity = 1, 12099-1294-01, FCC Label • Quantity = 1, 12099-1388-01, Front Cover • Quantity = 2, W55-0032-016, Cable, Flex Flat, 1 MM, 16 Cond	
12099-1203-02	Conversion Kit, CH-100, Remote to Front Contains: • Quantity = 1, 12099-1294-01, FCC Label • Quantity = 1, 12099-2594-01, Bracket, Interface, Assembly	

[8] This part is not field-replaceable and must be returned to L3Harris for replacement.

7. TECHNICAL ASSISTANCE

If any of the radio equipment requires repair, or if there are questions or concerns about the installation of this equipment, contact the L3Harris Technical Assistance Center (TAC) using the following telephone numbers or e-mail address:

North America:	1-800-528-7711
International:	1-434-385-2400
Fax:	1-434-455-6712
E-mail:	PSPC_tac@l3harris.com

8. CATALOG AND PART NUMBERS

8.1 RADIOS AND CONTROL HEADS

Table 8-1: Unity XG-100M and CH-100/CH-721 Part Numbers

CATALOG NUMBER	PART NUMBER	DESCRIPTION
XM-100F	12099-1000-01	XG-100M Mobile Radio; 136 to 870 MHz; Unencrypted; without Control Head (for front or remote-mount radio applications)
XM-100F-D01	12099-1000-01	XG-100M Mobile Radio; 136 to 520 MHz; Unencrypted; without Control Head (for front or remote-mount radio applications)
XM-100F-D02	12099-1000-01	XG-100M Mobile Radio; 136 to 174 and 762 to 870 MHz; Unencrypted; without Control Head (for front or remote-mount radio applications)
XM-100F-D03	12099-1000-01	XG-100M Mobile Radio; 380 to 870 MHz; Unencrypted; without Control Head (for front or remote-mount radio applications)
XMCP9R	12099-1200-01	CH-100 Control Head, Remote-Control (for use with a remote-mount radio)
XMCP9Q	12099-1200-02	CH-100 Control Head, Local-Control (for use on a front-mount radio)
XMCP9E	CU23218-0002	CH-721 Scan Control Head, Remote-Control (for use with a remote-mount radio)
XMCP9F	CU23218-0004	CH-721 System Control Head, Remote-Control (for use with a remote-mount radio)
XMCP9G	CU23218-0001	CH-721 Scan Control Head, Local-Control (for use on a front-mount radio)
XMCP9H	CU23218-0003	CH-721 System Control Head, Remote-Control (for use on a front-mount radio)
XMCP9P	CU-017821-001	HHC-731 Hand-Held Controller

8.2 FEATURE PACKAGES

Table 8-2: Unity XG-100M Feature Packages

CATALOG NUMBER	DESCRIPTION
XMPL4B	Feature Package: P25 Trunking Operational Mode (includes P25 conventional and analog conventional operation)
XMP25ED	Feature Package: P25 Trunking and EDACS Trunking (includes analog conventional operation)

Table 8-2: Unity XG-100M Feature Packages

CATALOG NUMBER	DESCRIPTION
XMPKGED	Feature Package: EDACS Trunking (includes analog conventional operation)
XMPL3X	Feature Package: EDACS Data
XMPL4C	Feature Package: P25 Encryption with AES and DES-OFB
XMPL4D	Feature Package: DES-CFB Encryption
XMPL4E	Feature Package: Conventional Vote Scan
XMPL4F	Feature Package: P25 Phase II TDMA
XMPL4G	Feature Package: P25 Data for Mobile Data Terminal (MDT), Radio TextLink, and Status Message Applications
XMPL5K	Feature Package: P25 ProFile Over-The-Air Programming (OTAP)
XMPL5L	Feature Package: Over-The-Air Rekeying (OTAR) for P25 Trunking and P25 Conventional Modes
XMPL7G	Feature Package: EDACS Security Key
XMPRO	Feature Package: ProVoice
XM-SP2V	Feature Package: Federal/International Standard

8.3 RADIO PROGRAMMING

Table 8-3: Unity Radio Programming Software and Cable

CATALOG/PART NUMBER	DESCRIPTION
SK-104768-001	Software: Radio Personality Manager.
TQS3416	Software: Key Manager. This package includes the Key Administrator application (media kit SK102979V1) and the Key Loader application (media kit SK102981V1) on CD ROM media, along with the respective manuals and software release notes.
14004-0206-01	Software: Radio Personality Manager 2 (RPM2). RPM2 R3A or later is required to program the XG-100M.
XMCL9M (Cat. No.) W95-0011-302 (Part No.)	Cable, USB Programming, Type A Plug to Mini Type B Plug (6.5 feet long)
CA-104861	Cable, Serial Programming, Male DB-9 to Female DB-9 (5 feet long)
XMCL8T (Cat. No.) CA-013671-020 (Part No.)	Cable, Serial Data, Male DB-9 to Female DB-9 (20 feet long)
XMCJ3C (Cat. No.) 12099-0410-A1 (Part No.)	Cable, KVL-3000+ Programming (100 inches uncoiled)

NOTE

Radio Personality Manager (RPM) release R8A or later is required for Unity XG-100M radio and CH-100 control head programming.

Radio Personality Manager (RPM) release R7A or later is required for Unity XG-100M radio and CH-721 control head programming.

Radio Personality Manager 2 (RPM2) release R3A or later is required for Unity XG-100M, CH-721, and CH-100 programming.

8.4 RADIO AND CONTROL HEAD FIRMWARE

Table 8-4: Radio Firmware (Non-XGP) - Contents of Distribution Kit ST-018940-001

PART NUMBER	DESCRIPTION
SK-018940-001	Firmware, Application: Unity XG-100M Mobile Radio (Non-XGP)
14221-1200-8060	Software Release Notes: Unity XG-100M Mobile Radio (Non-XGP)

Table 8-5: Radio Firmware (XGP) - Contents of Distribution Kit 14005-0132-01

PART NUMBER	DESCRIPTION
14004-0132-01	Firmware, Application: Unity XG-100M Mobile Radio, XGP
14221-1100-8140	Software Release Notes: Unity Portable/Mobile, XGP

Table 8-6: Radio Firmware (XLP) - Contents of Distribution Kit 14005-0229-01

PART NUMBER	DESCRIPTION
14004-0229-01	Firmware, Application: Unity XG-100M Mobile Radio, XLP
14221-1800-8000	Software Release Notes: XLP

Table 8-7: Radio Burn and Boot Applications (Normally Distributed via Tech-Link or Software Services)

PART NUMBER	DESCRIPTION
14004-0020-01	Firmware, Burn Application: Unity XG-100M Mobile Radio
14004-0021-01	Firmware, Boot Application: Unity XG-100M Mobile Radio

Table 8-8: CH-100 Firmware (Non-XGP) - Contents of Distribution Kit 14005-0033-01

PART NUMBER	DESCRIPTION
14004-0033-01	Firmware, Main Application: CH-100 Control Head (Non-XGP)
14221-1200-8070	Software Release Notes: CH-100 Control Head

Table 8-9: CH-100 Firmware, XGP - Contents of Distribution Kit 14005-0134-01

PART NUMBER	DESCRIPTION
14004-0134-01	Firmware, Main Application: CH-100 Control Head, XGP
14221-1100-8140	Software Release Notes: Unity Portable/Mobile, XGP

Table 8-10: CH-100 Firmware (XLP) - Contents of Distribution Kit 14005-0230-01

PART NUMBER	DESCRIPTION
14004-0230-01	Firmware, Application: CH-100, XLP
14221-1800-8000	Software Release Notes: XLP

Table 8-11: CH-721 Firmware - Contents of Distribution Kit ST-011241-001

PART NUMBER	DESCRIPTION
SK-011241-001	Firmware, Main Application: CH-721 Control Head
SK-011975-001	Firmware, BurnApp Application: CH-721 Control Head
SK-011976-001	Firmware, AppBurn Application: CH-721 Control Head
MS-013563-001	Software Release Notes: CH-721 Control Head

8.5 INSTALLATION-RELATED COMPONENTS

For detailed information on installation-related components, such as DC power cables, CAN cables, option/accessory cables, antenna elements and antenna mounts, refer to the *Installation Manual* 14221-1200-4440. The manual's publication number, along with related information is listed in Section 5.

9. OPERATING INFORMATION

Operating information for the Unity XG-100M mobile radio is contained in the radio's Quick Guides and Operator's Manuals. A Quick Guide is included with the radio equipment package when the package ships from the factory. All related publications are available at www.pspc.harris.com via an Information Center login and Tech Link. Refer to Section 5 on page 24 for additional information.

10. PROGRAMMING THE RADIO

NOTE

If using RPM2 to perform any of the procedures in the following sections, refer to the *RPM2 User's Manual*, 14221-1100-2060, for descriptions of the user interface, menus, operation, etc.

10.1 GENERAL INFORMATION

L3Harris Radio Personality Manager (RPM/RPM2) is a Microsoft® Windows®-based software application used to program L3Harris radios operating in conventional, P25 conventional, P25 trunking, EDACS®, EDACS IP and ProVoice radio systems. The RPM application is used to create and modify radio personalities, which become mission plans when written to the Unity XG-100M mobile radio. It can also be used to update radio firmware. RPM supports many L3Harris radios such as the P7100, P7200, P7300, and XG-100P portable radios, and the M7100, M7200, M7300, and Unity XG-100M mobile radios.

Personalities/mission plans are downloaded from the Personal Computer (PC) running RPM to the radio. Using RPM, they can also be extracted (read) from the radio, modified as needed, and then re-written (programmed) to the radio. They contain data that configure the radio for unique customer requirements, such as radio frequency sets, unit, and group trunk mode identification, etc. The technician can program personalities/mission plans into the radio or read them from the radio and save them to a hard drive or other computer storage media.

Applicable catalog and part numbers are listed in Table 8-3 on page 30. For additional information about RPM, refer to its online help and/or *RPM Software Release Notes MS-012550-001*. For additional information about RPM2, refer to its online help, *RPM2 Software Release Notes 14221-1100-8170*, or *RPM2 User's Manual* 14221-1100-2060.

An XG-100M radio with a CH-100 control head can use a TIA/EIA/RS-232C serial cable connection, a USB serial cable connection, or a Bluetooth wireless connection for programming operations (Bluetooth programming not supported in RPM2). The TIA/EIA/RS-232C serial cable connects to the 9-pin D-subminiature (DB-9) connector on the rear of the radio. For USB and Bluetooth links, the CH-100 control head provides the connection path.

An XG-100M radio with a CH-721 control head must use a TIA/EIA/RS-232C serial cable connection for programming. The serial cable connects to the 9-pin D-subminiature (DB-9) connector on the rear of the radio.

Both cases above include front-mount radios (i.e., radio with an attached control head) and remote-mount radios (i.e., radios with a separate/remote control head).

NOTE

A USB or a Bluetooth link is the preferred connection method for an XG-100M radio with a CH-100 control head (Bluetooth programming is not supported in RPM2). These links support programming of up to ten (10) personalities/mission plans into the radio. Only one personality/mission plan is active at a time.

An XG-100M radio with a CH-721 control head can only have one (1) personality/mission plan and it is always active.

A personality/mission plan loaded into the radio via a TIA/EIA/RS-232C serial link **cannot** be extracted (read back) via a USB or Bluetooth link.

10.2 ESTABLISHING A PROGRAMMING LINK

10.2.1 Establishing an RS-232C Connection with a Radio

If the XG-100M mobile radio has a CH-721 control head (local or remote), the PC must be connected to the radio via a TIA/EIA/RS-232C serial connection. Use this procedure to establish this connection:

1. Obtain Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent.
2. Power-up the PC that has RPM installed on it.
3. As illustrated in Figure 10-1, mate the cable's male 9-pin connector to the female 9-pin connector on the rear of the radio. Lightly tighten the two (2) jackscrews.
4. Mate the cable's female 9-pin connector to the male 9-pin serial port connector of the PC.

NOTE

If the utilized PC is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232C Adapter Cable CN24741-0001. CN24741-0001 is available via the Customer Care center; refer to Section 6 on page 25 for contact information.

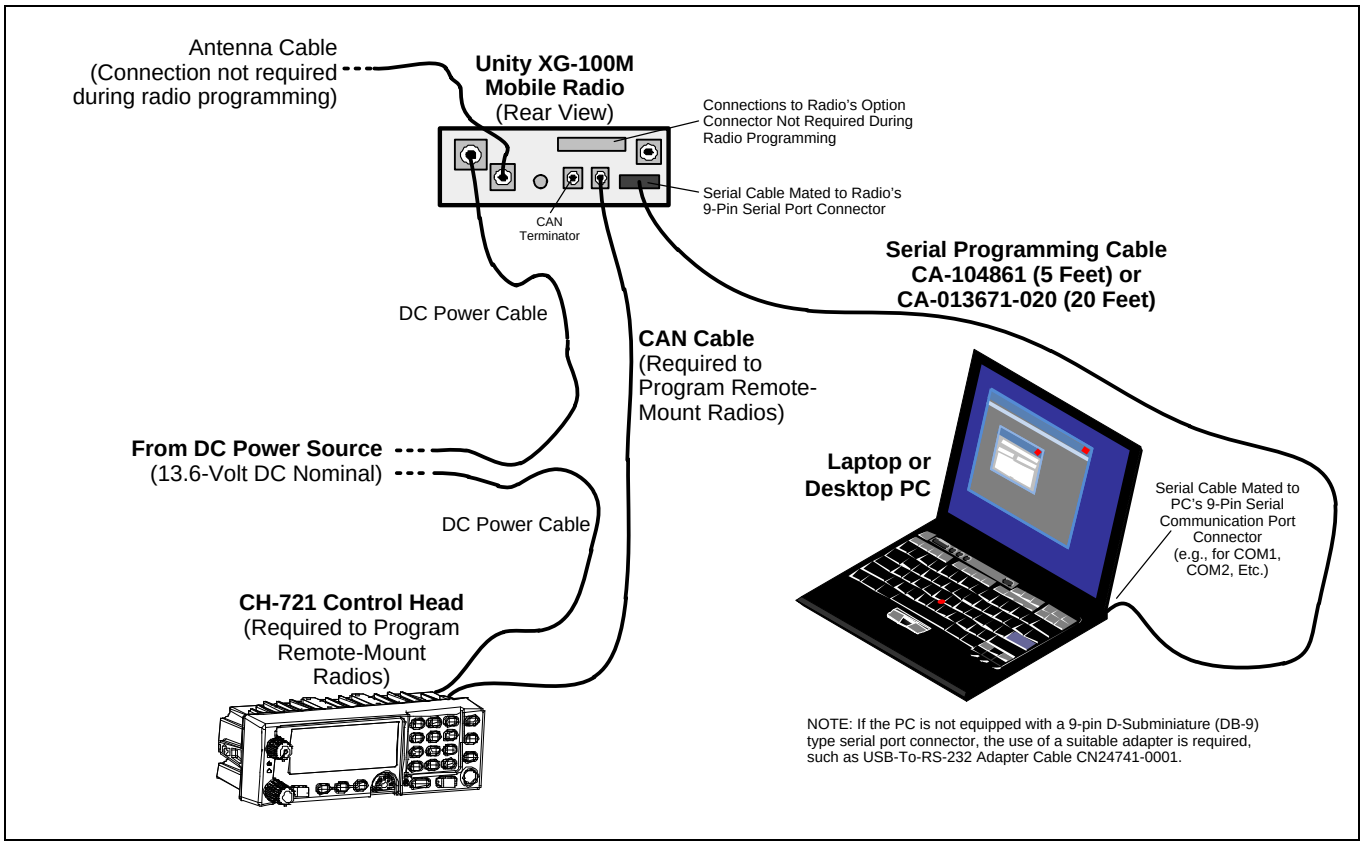

Antenna Cable
(Connection not required during radio programming)
Unity XG-100M Mobile Radio
(Rear View)
Connections to Radio's Option Connector Not Required During Radio Programming
Serial Cable Mated to Radio's 9-Pin Serial Port Connector
CAN Terminator
Serial Programming Cable CA-104861 (5 Feet) or CA-013671-020 (20 Feet)
DC Power Cable
CAN Cable
(Required to Program Remote-Mount Radios)
From DC Power Source
(13.6-Volt DC Nominal)
Laptop or Desktop PC
Serial Cable Mated to PC's 9-Pin Serial Communication Port Connector (e.g., for COM1, COM2, Etc.)
DC Power Cable
CH-721 Control Head
(Required to Program Remote-Mount Radios)
NOTE: If the PC is not equipped with a 9-pin D-Subminiature (DB-9) type serial port connector, the use of a suitable adapter is required, such as USB-To-RS-232 Adapter Cable CN24741-0001.

Figure 10-1: Cable Connections for Radio Programming via an RS-232C Serial Cable Link

5. Start RPM.
6. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.

7. Power-up the radio via the control head's on/off/volume control.
8. Program the radio with RPM as required. Flash programming information is included in Section 10.3 which begins on page 37. Personality/mission plan programming information is included in Section 10.4 which begins on page 42.

10.2.2 Establishing a USB Connection with the XG-100M and CH-100

If the XG-100M mobile radio has a CH-100 control head (local or remote), the PC can be linked to the radio via a USB or Bluetooth connection. Use this procedure to establish a USB connection:

1. Obtain USB Programming Cable W95-0011-302. The respective catalog number is listed in Table 8-3 on page 30.
2. Power-up the PC that has RPM installed on it.
3. On the front panel of the CH-100 control head, flip the dust cap off the control head's USB connector. This cap and connector are located on the right side of the front panel, as viewing the front panel.
4. Mate the cable's small USB connector to the control head's USB connector.
5. Mate the cable's larger USB connector to a USB port on the PC.
6. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.
7. Power-up the radio and control head using the control head's on/off/volume control.
8. If prompted with a **Found New Hardware** wizard, accept all prompts to allow the installation of the USB driver software.

NOTE

Programming via a USB connection requires installation of USB driver software. This driver allows the radio to communicate with the PC via a USB port connection. The driver is included with the RPM installation software package.

9. Continue by programming the radio with the RPM application as required. Section 10.4.2 describes how to extract a mission plan from a radio (i.e., read a personality/mission plan) and Section 10.4.3 describes how to program a personality/mission plan to a radio. Flash programming information is included in Section 10.3 which begins on page 37.

10.2.3 Establishing a Bluetooth Wireless Link with the XG-100M and CH-100

NOTE

RPM2 does not support programming via Bluetooth.

If the XG-100M mobile radio has a CH-100 control head (local or remote) and the PC with the RPM software application has Bluetooth capability, a wireless Bluetooth data link can be used to program the radio with RPM. The total number of radios that can be simultaneously connected to RPM via Bluetooth is limited only by the number of COM ports available for the PC's Bluetooth radio/adapter.

NOTE

The radio's Bluetooth operation and/or menu can be enabled and disabled via RPM. If Bluetooth operation has been disabled, the radio cannot be connected via a Bluetooth connection. In this case, an RS-232C or USB connection is required to re-enable Bluetooth via RPM personality/mission plan changes and a subsequent download via the respective cable. To enable and disable Bluetooth within a personality, use RPM's **Bluetooth Settings** dialog box (access via **Personality Data Tree → Options → Bluetooth Settings**).

Use this procedure to establish a Bluetooth wireless link between the PC and radio/control head:

1. Verify the PC's Bluetooth wireless adapter (internal or external) is powered-up. For example, some notebook/laptop PCs have switches which power their internal wireless adapters on and off.
2. If the PC's network name is not known, browse to **My Computer** in Windows, select **Properties**, select the **Computer Name** tab, and make a note of the name (i.e., the "full computer name").
3. If not already, enable/activate the PC's Bluetooth software and set it to discovery mode.
4. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.
5. Power-up the radio and control head via the control head's on/off/volume control.
6. Wirelessly "pair" (connect) the radio and control head to the PC as follows:
   a. From the control head's **MAIN MENU**, select the **SETTINGS** menu, then the **BLUETOOTH SETTINGS** submenu.
   b. Optional: Select **PAIRED DEVICES** to view the names of any other devices already connected to the control head via a Bluetooth wireless link.
   c. If not already enabled, enable Bluetooth by setting **ENABLED** to **ON**.
   d. Select **FIND DEVICE** and wait for the Bluetooth scan to complete.
   e. Select the + beside the PC's network name. A pairing in progress prompt briefly appears in the control head's display. If the PC's network name does not appear in the list, the PC's Bluetooth software should be changed to discovery mode.
   f. If connecting to a PC with Bluetooth 2.0, enter the pin code/passkey when prompted, and touch **OK**.

      If connecting to a PC with Bluetooth 2.1, touch **ACCEPT** when the accept/deny prompt appears, and accept/acknowledge the connection at the PC when prompted.
   g. Optional: At the PC, select **PAIRED DEVICES**, to verify the control head-to-PC connection.

NOTE

If no paired connection can be established, use the **DELETE** (or **DELETE ALL**) function in the **PAIRED DEVICES** submenu to delete, and then add the PC again with the + function in **FIND DEVICE**.

7. Continue by programming the radio with RPM. Section 10.4.2 describes how to extract a mission plan from a radio (i.e., read a personality/mission plan). Section 10.4.3 describes how to program a personality/mission plan to a radio. Flash programming information is included in Section 10.3 which begins on page 37.

10.3 FLASH PROGRAMMING RADIO FIRMWARE

The radio's application firmware code is loaded into the radio before it ships from the factory and typically this procedure can be bypassed. However, in some cases, before the radio is deployed for use, code must be updated.

CAUTION

Before flash programming a radio, consult with the L3Harris Technical Assistance Center (TAC) and/or the respective Software Release Notes, as necessary. TAC contact information is included on page 28 of this manual. Software Release Notes are available at www.pspc.harris.com via a PSPC Systems Information Center login and Tech Link.

10.3.1 Obtaining a Radio's Current Firmware Codes' Versions

The radio's operating system firmware code version, AES encryption firmware code version, and DES encryption firmware code version can be obtained either directly from the control head, or if connected via USB or Bluetooth, from RPM.

10.3.1.1 Obtaining Firmware Codes' Versions Directly from the Control Head

10.3.1.1.1 From the CH-100 Control Head

To obtain radio firmware codes' versions directly from the CH-100 control head, from the **MAIN MENU**, enter the **UTILITIES** menu and then select **RADIO INFO**. The current operating system firmware version for the control head is reported in the **CH SW** field. The current operating system firmware version for the radio is reported in the **RADIO SW** field. The AES and DES code versions are reported in the **AES** and **DES** fields respectively.

NOTE

It is important to keep the **radio and control head** firmware updated. There may be dependencies between the respective software packages. Consult the respective Software Release Notes, as necessary.

10.3.1.1.2 From the CH-721 Control Head

To obtain radio firmware code versions directly from the CH-721 control head, press the control head's **MENU** button, then use the •/•• ramp control to scroll through the menu until **REVISION** appears in the middle line of the display, and then press the **MENU** button again. Next, use the •/•• ramp control to scroll for the desired versions.

10.3.1.2 Obtaining Firmware Codes' Versions from RPM

The firmware codes' versions can also be obtained from RPM if connected via USB or Bluetooth link. Follow this procedure:

1. Establish a USB or Bluetooth connection between the radio/control head and PC. As necessary, refer to Section 10.2.2 for a USB Connection, or Section 10.2.3 for a Bluetooth connection.
2. Start RPM by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Radio Personality Manager → Radio Personality Manager**. Refer to RPM's online help for programming information.
3. In RPM, click on the icon in the toolbar, or from the **Radio** menu, select **USB/Bluetooth Connection → Unity Product Management**. The **Unity Product Management** dialog box opens. Example dialog boxes are shown in Figure 10-4 and Figure 10-5.

4. If the radio is currently connected to the PC via a USB connection, it is automatically added just after the **Unity Product Management** dialog box opens. In this case, skip to step 8.
5. Click the Bluetooth button/icon. The **Radio Connection Configuration** dialog box opens.
6. Use this dialog box's drop-down to select the proper COM port number. Typically, the correct port number can be obtained from a Bluetooth applet within the Windows Control Panel.

NOTE

If the COM port number is not known, obtain it from the **Ports (COM & LPT)** section of the Microsoft Windows Device Manager, or from the configuration section of the PC's Bluetooth adapter software. For Bluetooth connections, more than one COM port may be available.

7. Click the **Add Radio** button to add the radio to the **Radio Information** list.
8. Read the radio's firmware versions in the **Radio Information** list.

10.3.2 Flashing the Radio via an RS-232C Serial Connection

Firmware is loaded into the radio before it ships from the factory and typically this procedure can be bypassed. In some cases, before the radio is deployed for use or when firmware enhancements are made, it must be updated by flash-loading new firmware. Follow this procedure to load firmware code into the XG-100M mobile radio via an RS-232C serial connection:

1. As illustrated in Figure 10-1, connect the radio to a personal computer with RPM installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio.

NOTE

If the utilized PC is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232C Adapter Cable CN24741-0001. CN24741-0001 is available via the Customer Care center; refer to Section 6 on page 25 for contact information.

2. Power-up the PC on which RPM is installed.
3. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.
4. Power-up the radio and control head.
5. Start RPM.
6. In RPM, click **Tools → Comm Port Setting,** select the respective serial communications port, and click the **OK** button.
7. Click the **Radio** menu, and then click **Standard Serial Connection → Load Compressed Code**.
8. In the **Load Code** dialog box, click to select a **Code Type** of **ECP/XGP** (or just **ECP** for RPM Release R09B and earlier).
9. Click the ... button and then select the location of the XG-100M radio's compressed firmware code file, named **xg100muen_RxxXxx.cmp** (where **RxxXxx** is the required software version).

NOTE

The compressed firmware code file is included with the respective firmware kit supplied on Compact Disk (CD) media. Refer to Section 8.4 on page 31 for additional information.

10. After selecting the correct code file, click the **Open** button, and then click the **Load** button.
11. RPM will begin loading the selected code to the radio, with load status displayed in a small **Status** box. The code is loaded successfully when the **Status** box displays **Done! Programming completed successfully.**
12. After this message is displayed, click the **Load Code** dialog box's **Done** button.
13. Control head firmware may also need updating. Consult the respective Software Release Notes, as necessary. Otherwise, continue by loading personalities/mission plans.

10.3.3 Flash Programming a Radio via a USB or Bluetooth Connection

10.3.3.1 Flashing Operating System Firmware

Firmware is loaded into the radio before it ships from the factory and typically this procedure can be bypassed. In some cases, before the radio is deployed for use or when firmware enhancements are made, it must be updated. Follow this procedure to flash program new firmware to a radio via a USB or Bluetooth connection. Approximately ten (10) minute is required:

1. Establish a USB or Bluetooth connection between the radio/control head and PC. Refer to Section 10.2.2 for a USB Connection, or Section 10.2.3 for a Bluetooth connection.
2. Add the radio to RPM's **Radio Information** list. See Section 10.3.1.2 steps 2 through 7 as necessary.
3. If the personalities/mission plans currently stored in the radio must be maintained and they are not stored separately on a computer, extract (read) and save them. Refer to Section 10.4.2 as necessary.
4. Click the dialog box's **Code Modules** Tab. Verify the **Radio Firmware** option is selected. If not, click on it to select.
5. Use the **Browse** button and the accompanying dialog box to browse to and select the proper compressed firmware code file (uses a "**cmp**" file extension). After selecting the file, click **Open** to return to the **Code Modules** tab.

NOTE

The compressed firmware code file is included with the respective firmware kit supplied on Compact Disk (CD) media. Refer to Section 8.4 on page 31 for additional information.

6. Click the **Program** button to write the selected firmware to the radio. Installation prompts will appear within RPM as the firmware is written to the control head and radio. Accept all prompts that appear. This process takes several minutes. Afterwards, an "updating firmware" prompt appears on the control head's display as the firmware is copied from the radio's temporary memory to non-volatile (flash) memory. This process takes several minutes. Next, the radio re-boots and displays a "first run setup" prompt. Finally, a "mission fill" prompt displays and the radio and control head return to normal operation.
7. Flash/re-flash required encryption modules into the radio as described in Section 10.3.3.2.
8. Re-program required personalities/mission plans into the radio as described in Section 10.4.3.

9. Control head firmware may also need updating. Consult the respective Software Release Notes, as necessary. Otherwise, continue by loading personalities/mission plans.

NOTE

It is important to keep the **radio and control head** firmware updated. There may be dependencies between the respective software packages. Consult the respective Software Release Notes, as necessary.

10.3.3.2 Flashing AES and DES Encryption Firmware (Encryption Modules)

AES and/or DES encryption firmware may or may not be loaded into the radio before it ships from the factory. If necessary, follow this procedure to flash program this firmware to a radio:

1. Establish a USB or Bluetooth connection between the radio/control head and PC. As necessary, refer to Section 10.2.2 for a USB Connection, or Section 10.2.3 for a Bluetooth connection.
2. Add the radio to RPM's **Radio Information** list. See Section 10.3.1.2 steps 2 through 7 as necessary.
3. Click the dialog box's **Code Modules** tab.
4. Select the **Encryption Module** option.
5. Use the **Browse** button and the accompanying dialog box to browse to and select the proper encryption firmware file (uses an "**ess**" file extension). After selecting the file, click the **Open** button to return to the **Code Modules** tab.
6. Click the **Program** button to write the selected firmware to the radio.

10.3.4 Flashing CH-100 Control Head Firmware

NOTE

This procedure requires RPM release R8A or later.

Firmware is loaded into the control head before it ships from the factory and typically this procedure can be bypassed. In some cases, before the control head is deployed for use or when firmware enhancements are made, it must be updated by flash-loading new firmware. Follow this procedure to flash program new firmware to a control head. Typically, it takes six (6) to seven (7) minutes:

1. Establish a USB or Bluetooth connection between the radio/control head and PC. As necessary, refer to Section 10.2.2 for a USB Connection, or Section 10.2.3 for a Bluetooth connection.
2. Start RPM by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Radio Personality Manager → Radio Personality Manager**. Refer to RPM's online help for programming information.
3. In RPM, click on the icon in the toolbar, or from the **Radio** menu, select **USB/Bluetooth Connection → Unity Product Management**. The **Unity Product Management** dialog box opens.
4. If the control head is currently connected to the PC via a USB connection, it is automatically added just after the **Unity Product Management** dialog box opens. In this case, skip to step 8.
5. Click the Bluetooth button/icon. The **Radio Connection Configuration** dialog box opens.

6. Use this dialog box's drop-down to select the proper COM port number. Typically, the correct port number can be obtained from a Bluetooth applet within the Windows Control Panel.
7. Click the **Add Radio** button to add the control head to the list.
8. Click the dialog box's **Code Modules** tab.
9. Click the **Control Head Firmware** option.
10. Use the **Browse** button and the accompanying dialog box to browse to and select the proper firmware file (uses a "**dss**" file extension). After selecting the file, click the **Open** button to return to the **Code Modules** tab.
11. Click the **Program** button to write the selected firmware to the control head. Installation prompts will appear within RPM as the firmware is written to the control head. This process takes several minutes. Afterwards, an "updating firmware" prompt appears on the control head's display as the firmware is copied from the control head's temporary memory to non-volatile (flash) memory. This process takes several minutes. Next, the control head re-boots and displays a "first run setup" prompt. Finally, it displays a "mission fill" prompt and then it returns to normal operation.
12. Radio firmware may also need updating. Consult the respective Software Release Notes, as necessary.

NOTE

It is important to keep the **radio and control head** firmware updated. There may be dependencies between the respective software packages. Consult the respective Software Release Notes, as necessary.

10.3.5 Flashing CH-721 Control Head Firmware

Firmware is loaded into the control head before it ships from the factory and typically this procedure can be bypassed. However, in some cases, before the control head is deployed for use or when firmware enhancements are made, it must be updated. Follow this procedure to flash program new firmware to a control head:

1. Connect the control head to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio.
2. Power-up the control head.
3. Start the RPM application by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Radio Personality Manager → Radio Personality Manager**. Refer to RPM's online help for programming information.
4. In RPM, click the **Radio** menu, and then click **Standard Serial Connection → Load Compressed Code**.
5. In the **Load Code** dialog box's COM **Port** drop-down list, click to select the respective serial port.
6. Click to select the **CH721 MainApp** option.
7. Click the ... button and then select the location of the control head's compressed firmware code file. Refer to the respective Software Release Notes for additional information.
8. Click the **Load** button to flash the selected firmware to the control head. This process takes several minutes.
9. After the flash procedure is complete, click the dialog box's **Done** button to exit.

10. Power-cycle the control head.
11. Radio firmware may also need updating. Consult the respective Software Release Notes, as necessary.

10.4 RADIO PERSONALITY PROGRAMMING

10.4.1 Personality Programming via an RS-232C Serial Connection

A personality/mission plan can be written to the radio via an RS-232C serial data link:

NOTE

This procedure must be used for an XG-100M radio with a CH-721 control head.

1. Connect the radio to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio. Connections are illustrated in Figure 10-1.
2. Power-up the PC that has RPM installed on it.
3. Start RPM.
4. Open an existing XG-100M radio personality, create a new XG-100M personality, or read the existing personality from the radio. Consult RPM's online help, as necessary.
5. As illustrated in Figure 10-2, in RPM's main dialog box, verify the **Radio Type** is set to **Unity XG-100 Mobile/CH-100** if the CH-100 control head is present or to **Unity XG-100 Mobile/CH-721** if the CH-721 control head is present.

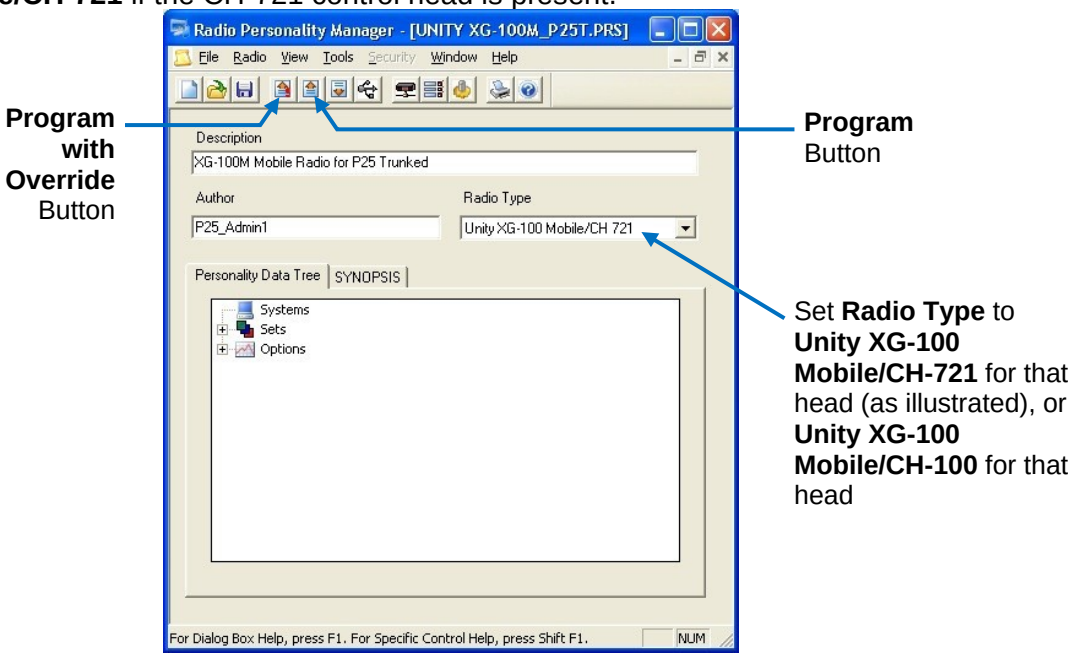

Program with Override Button
Program Button
Set Radio Type to Unity XG-100 Mobile/CH-721 for that head (as illustrated), or Unity XG-100 Mobile/CH-100 for that head
Radio Personality Manager - [UNITY XG-100M_P25T.PRS]
File Radio View Tools Security Window Help
Description
XG-100M Mobile Radio for P25 Trunked
Author
Radio Type
P25_Admin1
Unity XG-100 Mobile/CH 721
Personality Data Tree
SYNOPSIS
Systems
Sets
Options
For Dialog Box Help, press F1. For Specific Control Help, press Shift F1.
NUM

Figure 10-2: RPM's Program and Program with Override Buttons (Example Main Dialog Box)

6. Complete the personality programming as required for the radio. Consult with the radio system(s) network administration personnel and/or RPM's online help, as necessary.
7. Save the personality, using a unique filename if necessary.

8. If logical ID (LID) values and the radio's IP address (if required) currently in the personality are correct for this radio, click on the **Program** button in the RPM toolbar.

   Otherwise, in RPM's toolbar, click the **Program with Override** button and in the **Override Options** dialog box, enter the radio's LID numbers and other relative information as required for the respective radio. Ignore the EDACS LID. Consult with radio network administration personnel, as necessary. The following figure shows example P25 logical ID numbers only:

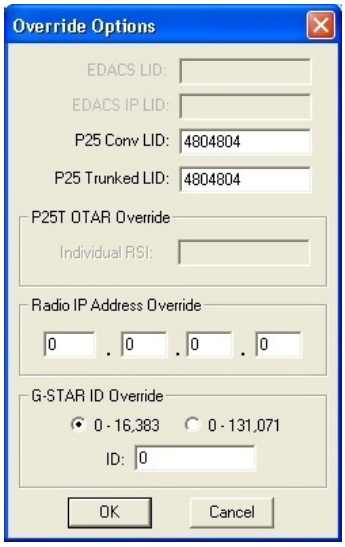


Figure 10-3: RPM's Override Options Dialog Box (with Example LID Numbers)

9. Click **OK** to start the personality write operation. After it is written, the radio automatically reboots.

10. Disconnect cables and check for proper radio operation.

10.4.2 Extracting (Reading) a Mission Plan from a Radio(s)

With the CH-100 control head, the radio can store up to ten (10) different mission plans. Each mission plan can be extracted (read) from the radio by RPM, edited with RPM as a personality, and then re-written to the radio and/or saved to computer storage media such as the PC's hard disk drive. Alternately, within RPM, a new mission plan can be created or made from an existing personality, and then rewritten to the radio.

NOTE

A USB or a Bluetooth link is the preferred connection method for an XG-100M radio with a CH-100 control head. These links support programming of up to ten (10) personalities/mission plans into the radio. Only one personality/mission plan is active at a time.

An XG-100M radio with a CH-721 control head can only have one (1) personality/mission plan and it is always active.

A personality/mission plan loaded into the radio via a TIA/EIA/RS-232C serial link **cannot** be extracted (read back) via a USB or Bluetooth link.

To extract a mission plan from one or more radios:

1. Establish a USB or Bluetooth connection between the radio/control head and PC. As necessary, refer to Section 10.2.2 for a USB Connection, or Section 10.2.3 for a Bluetooth connection.

2. Add the radio to RPM's **Radio Information** list. See Section 10.3.1.2 steps 2 through 7 as necessary.

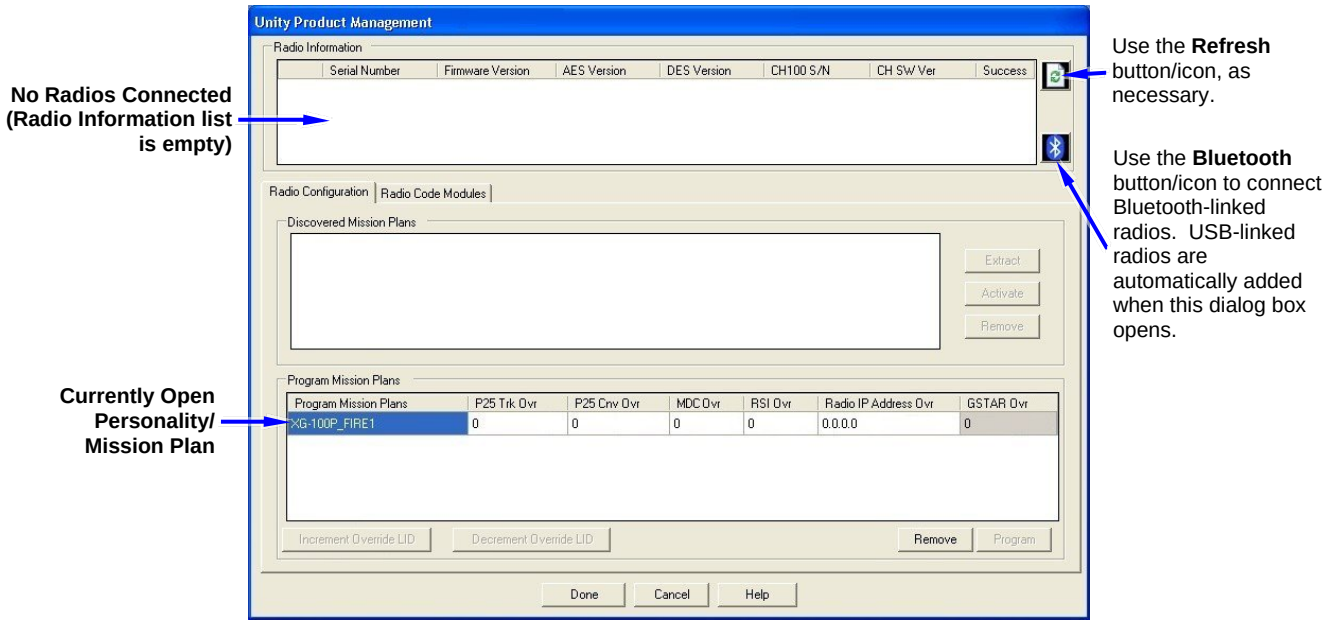


Figure 10-4: Unity Product Management Dialog Box (Example with no Radios Connected)

NOTE

In the **Unity Product Management** dialog box, the connected radio's information appears in the **Radio Information** section, mission plans stored in the selected radio appear in the **Discovered Mission Plans** section, and currently open personalities/mission plans are displayed in the **Program Mission Plans** section.

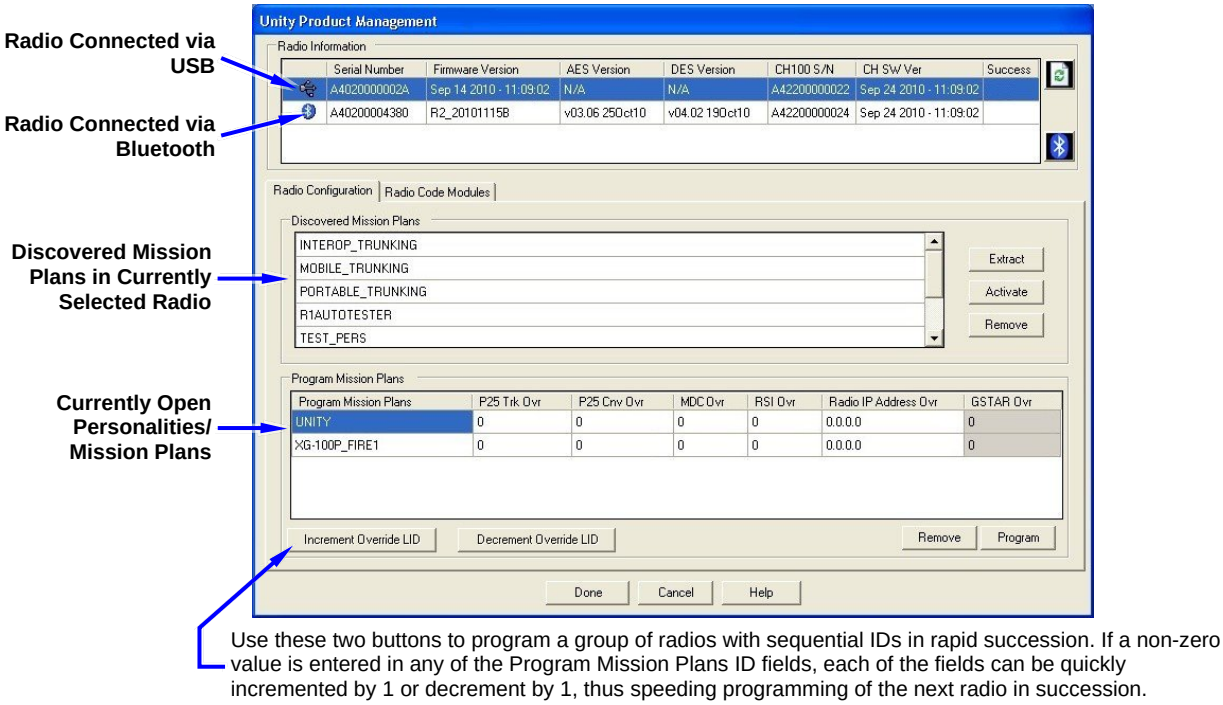


Figure 10-5: Unity Product Management Dialog Box (Example with two Radios Connected)

3. Optional: Add additional radios using a different COM port number for each radio. The total number of radios that can be added (i.e., connected for programming via RPM) is only limited by the number of available COM ports.
4. If more than one radio has been added, select the desired radio for mission plan extraction by clicking on its row (i.e., **Serial Number**, etc.) in the dialog box's **Radio Information** section. The row highlights, and the **Discovered Mission Plans** section in the **Radio Configuration** tab updates accordingly.
5. In the dialog box's **Radio Configuration** tab, select the desired mission plan(s) for extraction from the **Discovered Mission Plans** list, and then click the **Extract** button. Select multiple mission plans by holding the PC keyboard's **<Ctrl>** key or **<Shift>** key, and then clicking on the mission plan names. Upon successful extraction of the mission plan(s), a confirmation message box appears.
6. Click this message box's **OK** button to continue.
7. Click the **Unity Product Management** dialog box's **Done** button. Each extracted mission plan opens as a new personality window within RPM. Otherwise, click the dialog box's **Cancel** button to exit this dialog box and return to RPM's normal personality screen.
8. Make personality/mission plan modifications as required. For additional information on using RPM, refer to its online help and/or the respective Software Release Notes.
9. Recommended but not required: Save the personality, using a unique filename if necessary.
10. Optional: Write the modified personality/mission plan back to the radio using the procedure in the following section.

10.4.3 Programming (Writing) Personalities/Mission Plans to a Radio

To program a personalities/mission plans to a radio:

1. Establish a USB or Bluetooth connection between the radio's control head and PC using the procedures in Sections 10.2.2 or 10.2.3 respectively.
2. Start the RPM application by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Radio Personality Manager → Radio Personality Manager**. Refer to RPM's online help for programming information.
3. Open the personalities that must be programmed (i.e., written) to the radio. If a personality/mission plan needs to be sourced from a different radio and it is not currently stored on the PC's hard disk (or other media), first extract the personality/mission plan form the source radio, edit it as necessary using RPM, and save it.
4. In RPM, click on the icon in the toolbar, or from the **Radio** menu, select **USB/Bluetooth Connection → Unity Product Management**. The **Unity Product Management** dialog box opens. Example dialog boxes are shown in Figure 10-4 and Figure 10-5.

NOTE

In the **Unity Product Management** dialog box, the connected radio's information appears in the **Radio Information** section, and mission plans stored in the selected radio appear in the **Discovered Mission Plans** section, and currently open personalities/mission plans are displayed in the **Program Mission Plans** section.

5. If the radio is currently connected to the PC via a USB connection, it is automatically added just after the **Unity Product Management** dialog box opens. In this case, skip to step 9.
6. If the radio is currently connected via Bluetooth, click the Bluetooth button/icon. The **Radio Connection Configuration** dialog box opens.

7. Select the required COM port number for the Bluetooth connection.

NOTE

If the COM port number is not known, obtain it from the **Ports (COM & LPT)** section of the Microsoft Windows Device Manager, or from the configuration section of the PC's Bluetooth adapter software. For Bluetooth connections, more than one COM port may be available.

8. Click the **Radio Connection Configuration** dialog box's **Add Radio** button.
9. Optional: To add additional radios, perform steps 6 through 8, using a different COM port number for each radio. The total number of radios that can be added (i.e., connected for programming via RPM) is only limited by the number of available COM ports.
10. Select the desired radio for mission plan programming by clicking on its row (i.e., **Serial Number**, etc.) in the dialog box's **Radio Information** section. Only one radio should be selected at a time during program operations. The row highlights, and the **Discovered Mission Plans** section in the **Radio Configuration** tab updates accordingly.
11. If a value override (such as the radio's P25 trunked logical ID number) is needed to any of personalities/mission plans listed in the dialog box's **Program Mission Plans** section, click in the respective cell, and enter the required value. Repeat as necessary for other overrides.

    Alternately, click the **Increment Override ID** button or the **Decrement Override ID** button to increment or decrement the current ID by 1.
12. In the dialog box's **Program Mission Plans** section, select the desired mission plan(s) for programming by clicking on its name in the **Program Mission Plans** column. Select multiple mission plans by holding the PC keyboard's **<Ctrl>** key or **<Shift>** key and clicking on the mission plan names.
13. Click the **Program** button. RPM displays status message boxes as the data is written to the radio. At the radio, an **INSTALL IN PROGRESS** message is displayed. If a mission plan of the same name is already programmed into the radio, a yes/no over-write confirmation message box is displayed. In this case, click the **Yes** button to over-write, or **No** to cancel.

10.4.4 Removing a Mission Plan via RPM (CH-100 Control Head Only)

When the CH-100 control head is employed, a mission plan stored in the radio can be removed (deleted) via RPM's **Unity Product Management** dialog box. Establish a connection to the radio, select the radio, select the desired mission plan's name in the dialog box's **Discovered Mission Plans** section, and click the **Remove** button. RPM displays status message boxes as the mission plan is removed from the radio. If necessary, select multiple mission plans for deletion by holding the PC keyboard's **<Ctrl>** key or **<Shift>** key, and clicking more than once.

10.4.5 Activating a Mission Plan via RPM (CH-100 Control Head Only)

Normally, a mission plan stored in the radio is activated for use via the CH-100 control head's **PROGRAM** menu. However, a mission plan can also be activated via RPM's **Unity Product Management** dialog box. Establish a connection to the radio, select the desired mission plan's name in the dialog box, and click the **Activate** button. After a short period, the selected mission plan activates at the radio.

NOTE

If a mission plan is activated that has Bluetooth operation turned off, the computer-to-radio wireless connection will be lost. In this case, a message is displayed after a short period.

NOTE

The CH-721 control head supports only one (1) personality/mission plan and it is always active.

10.5 ADDING SOFTWARE FEATURE PACKAGES TO THE RADIO

Software feature packages available for the Unity XG-100M radio are listed in Table 8-2 on page 29.

10.5.1 Displaying Currently Enabled Software Feature Packages

10.5.1.1 From the CH-100 Control Head

To display the currently enabled software feature packages from the CH-100 control head:

1. From the main menu, touch **UTILITIES** to go to the Utilities menu.
2. In the **UTILITIES** menu, touch **FEATURE INFO**. The radio's existing features are listed.
3. If necessary, touch (up) or (down) to scroll through the list.
4. Touch **FEATURE DATA** at the top of the display to display the respective feature data in a hexadecimal format.
5. Touch (left/back) to exit and return to the main menu.

10.5.1.2 From the CH-721 Control Head

To display the currently enabled software feature packages from the CH-721 control head:

1. If not already, use RPM to add the **FEATURES** programmable menu function to the radio's menu(s). Do this by modifying the personality/mission plan. In RPM, access the respective dialog box by double-clicking **Programmable Menus** on the **Options** limb of **RPM's Personality Data Tree**. There is one menu used during trunked operations and one menu used during conventional operations. Be sure to program/write the modified personality/mission plan to the radio.
2. At the CH-721 control head, press the **MENU** button, then use the •/•• ramp control to scroll through the menu until **FEATURES** appears in the middle line of the display.
3. Press the **MENU** button again to access the Features Encryption Display.
4. Press the •/•• ramp control up or down repeatedly to scroll through the list, as necessary. Feature numbers are displayed as a list of 2-digit numbers separated by spaces.
5. Press the **MENU** or **CLR** (Clear) button to exit the features list.

10.5.2 Enabling Software Feature Packages

The following steps apply to XG-100M with either CH-100 or CH-721.

To enable software feature packages in a radio:

1. Contact the L3Harris Technical Assistance Center (TAC) to obtain a new software feature data string for new (and existing) features. TAC contact information is listed on page 28. Be prepared to report the radio's serial number, new feature(s) needed, and the respective customer information.
2. Exit RPM if it is running.

3. Connect the radio to a personal computer with RPM installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio. Connections are illustrated in Figure 10-1.
4. Start RPM's Radio Maintenance Utility application by clicking **Start → (All) Programs → Harris Radio Personality Manager → Radio Maintenance Utility**.
5. On the utility's Radio menu, select **Comm Settings** and select the correct PC serial port that is connected to the radio.
6. Select the **P5x00/P7x00/M5300/M7x00/XG100M-CH721/XG75/XG25** tab.

NOTE

DO NOT select the **XG100P/XG100M-CH100** tab even if a CH-100 is attached.

7. On the utility's Radio menu, select **Read → Feature Data** from Radio to read the existing feature data string from the radio.
8. Click the **Feature Data Edit** button and replace the existing feature data string with the new feature data string supplied by TAC. If necessary, refer to the application's online help for additional information.
9. Click **OK**.
10. On the utility's Radio menu, select **Write → Feature Data to Radio** to send the new feature data string to the radio. The radio briefly displays an "install" prompt and the utility displays a Command Response dialog box.
11. Verify the dialog box reports the feature data transfer is complete.
12. Click **OK**.
13. Click **Jump** and verify the radio reboots to operational mode, then exit the utility.

10.6 ENCRYPTION KEYS

The Unity XG-100M mobile radio supports Type-3 (triple) DES-OFB, Type-3 DES-CFB, and 256-bit AES-256 encryption algorithms. Encryption keys can be managed with the L3Harris Key Manager software application or using the Motorola KVL 3000 Plus Key Variable Loader.

NOTE

The radio **must** be equipped with the CH-100 control head to utilize the KVL 3000 Plus Key Loader for key management.

10.6.1 Key Management with the L3Harris Key Manger

The L3Harris Key Manager software application assists in the management and distribution of encryption keys for high-security P25 and EDACS radio systems. Key Manager is used to manage encryption keys for many different-type L3Harris radios and most L3Harris system-level components such as dispatch consoles. It allows the user to load EDACS DES, P25 DES, P25 AES, and ProVoice AES keys. Key Manager consists of three applications: Key Administrator, Key Loader, and UKEK Loader. The Key Administrator is typically referred to as "Key Admin." See Table 8-3 on page 30 for the respective catalog and media kit numbers.

For detailed information on using the Key Manager software, refer to *Key Manager and Key Admin Overview and Operation Manual,* MM1000019423 and/or *Key Manager and Key Loader Overview and Operation Manual,* MM1000019424.

10.6.1.1 Loading UKEKs with UKEK Loader and RPM (for OTAR-Enabled Systems)

In a P25 trunked radio system, each encryption-capable radio is considered an Over-The-Air-Rekeying (OTAR) client. OTAR clients require a Unique Key-Encrypting-Key (UKEK), which permits secure communications on an individual basis with the network-based Key Management Facility (KMF) server. The UKEK is used to decrypt Key Encryption Keys (KEKs). Once a radio's OTAR options are properly configured and the OTAR UKEK is loaded, OTAR operations may begin. The radio receives Traffic Encryption Keys (TEKs) via OTAR from the radio network. TEKs are used to encrypt and decrypt voice and data traffic in a P25 trunked device.

UKEKs are loaded into L3Harris OTAR clients (target radios) using the UKEK Loader application. UKEK Loader is a part of Key Manager. UKEKs are typically loaded in the clear (unencrypted), as they are the first keys established in the radio.

With the CH-721 control head, UKEKs can only be loaded into a radio via the radio's TIA/EIA/RS-232C serial port. This is the 9-pin D-subminiature connector on the rear of the radio.

With the CH-100 control head, UKEKs can be loaded into a radio via the radio's TIA/EIA/RS-232C serial port, or the control head's USB port, or a Bluetooth link between the control head and the PC.

Encryption keys for communicating on P25 trunked radio networks are created by the radio network's Crypto Officer. Field personnel (e.g., "trusted technicians") typically do not have key creation privileges.

To load UKEKs from the UKEK Loader application:

1. **CH-100 Control Head:** Obtain USB Programming Cable W95-0011-302. The respective catalog number is listed in Table 8-3 on page 30.

   CH-721 Control Head: Obtain Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long).

2. Obtain the UKEK file and Storage Location Number (SLN) Binding Report information from the Crypto Officer (CO).

NOTE

Both AES and DES UKEKs can be contained within the same UKEK file.

3. Power-up the PC that has RPM and UKEK Loader applications installed on it.

NOTE

The Unity drivers must be installed before UKEKs can be loaded into the radio. The Unity drivers may be found on the Key Loader CD ("unity setup.exe") or on the Key Admin CD ("unity setup.exe").

4. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.
5. Power-up the radio and control head via the control head's on/off/volume control.

6. **CH-100 Control Head:** On the front panel of the CH-100 control head, flip the dust cap off the control head's USB connector. This cap and connector are located on the right side of the front panel, as viewing the front panel. Next, mate the USB cable's small connector to the control head's USB connector, and then mate the USB cable's larger connector to a USB port of the PC.

   CH-721 Control Head: Connect the serial cable between the 9-pin D-subminiature (DB-9) connector on the back of the **radio** and the PC's 9-pin serial port connector. Use an appropriate adapter if the PC does not have a 9-pin serial port connector.

7. Load the UKEK file from the Crypto Officer onto the PC.
8. Run RPM and setup the radio's personality according the SLN Binding Report information.
9. Setup the talk groups and the SLN mappings (Talk Group ID to SLN). This includes mapping SLNs to the "System" keys (PSTN, All Call, etc.).
10. Select the **P25 OTAR Options** and set the following:
    a) Set the OTAR Message Number Period (MNP) as defined by the System Administrator.
    b) Set the radio's Individual RSI (from the SLN Bindings Report).
    c) Set the KMF's RSI (from the SLN Bindings Report).
11. Select **Radio → Program** or click on the **Program** icon and write the personality to the radio.
12. Run the UKEK Loader application.
13. Open the UKEK file loaded in step 7.
14. Select the Target Device type (Auto-Detect is preferred) and click the **Load** button.
15. When prompted, enter your username and password, and click **OK**.

    The UKEK Loader reads the target device's identifying information, retrieves a UKEK of the proper algorithm type from the UKEK file, and downloads the UKEK to the target device at the proper SLN and keyset with the proper key ID.
16. Click the **Finish** button to exit the Key Loader application. New UKEKs have now been loaded and the radio is now ready to accept TEKs via OTAR with the trunked radio network.

10.6.1.2 Creating Keys with Key Admin (for Non-OTAR-Enabled Systems)

Radios operating in an analog conventional and/or P25 conventional radio systems cannot utilize OTAR operations to receive encryption keys. Keys must be created and loaded into radios using Key Manager's Key Admin and Key Loader applications. Keys are created and stored on a Distribution Security Device with Key Admin. Next, Key Loader is used to load keys from the Distribution Security Device to radios. Typically, these operations are performed only by the Crypto Officer (CO) or trusted technicians. Keys stored on a Distribution Security Device cannot be edited.

For detailed information on using the Key Manager software, refer to *Key Manager and Key Admin Overview and Operation Manual,* MM1000019423 and/or *Key Manager and Key Loader Overview and Operation Manual,* MM1000019424*.* These publications are available at www.pspc.harris.com via an Information Center login and Tech Link.

To create keys with the Key Admin application:

1. Obtain the Master Security Device and connect it to the PC with the Key Manager application. Typically, this device requires an adapter cable to connect it to a PC USB port.
2. At the PC, start the Key Admin application by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Key Manager → Harris Key Admin**.
3. Use Key Admin's **New Master Set** or **Load Existing Set** functions to create a key set. Refer to the application's online help for more information on creating keys.
4. Disconnect the Master Security Device and connect the Distribution Security Device to the PC.
5. Continue by creating a Distribution Security Device. This action writes the keys to the Distribution Security Device.
6. Continue by loading keys to radios per the following procedure.

10.6.1.3 Loading Keys with Key Loader (for Non-OTAR-Enabled Systems)

Key Loader is a part of the L3Harris Key Manager application. It can be used by the Crypto Officer (CO) or a trusted technician to load the encryption keys into the radio:

1. Obtain and connect the Distribution Security Device the PC with the Key Manager application. Typically, this device requires an adapter cable to connect it to a PC USB port.
2. **CH-100 Control Head:** Obtain USB Programming Cable W95-0011-302. The respective catalog number is listed in Table 8-3 on page 30.

   CH-721 Control Head: Obtain Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long).
3. **CH-100 Control Head:** On the front panel of the CH-100 control head, flip the dust cap off the control head's USB connector. This cap and connector are located on the right side of the front panel, as viewing the front panel. Next, mate the cable's small USB connector to the control head's USB connector, and then mate the cable's larger USB connector to a USB port of the PC.

   CH-721 Control Head: Connect the serial cable between the 9-pin D-subminiature (DB-9) connector on the back of the **radio** and the PC's 9-pin serial port connector. Use an appropriate adapter if the PC does not have a 9-pin serial port connector.
4. Remote-Mount Radio Only: Verify the radio is properly connected to the control head via a CAN cable and CAN terminators are installed at the radio and at the control head.
5. Power-up the radio and control head via the control head's on/off/volume control.
6. At the PC, start Key Loader by clicking its icon on the Windows desktop, or by clicking **Start → (All) Programs → Harris Key Manager → Harris Key Loader**.
7. At the Key Loader's Welcome dialog box, click the **Next** button.
8. Enter the password for the Distribution Security Device and click the **Authenticate** button.
9. Click **Next** and then click **Next** again.
10. Wait for the Key Loader to read the Distribution Set and then click **Next** again.
11. Select the required port from the drop-down list (typically **USB**) and click **Next** again.
12. Select the radio by clicking its serial number in the drop-down list and then click the **Load** button.

13. Click the **Finish** button.
14. If other radios must be loaded, repeat from step 3.

10.6.2 Key Management with the Motorola KVL 3000 Plus Loader

NOTE

The radio **must** be equipped with the CH-100 control head to utilize the KVL 3000 Plus Key Loader for key management.

10.6.2.1 Creating a Single Type-3 Encryption Key

A single Type-3 DES-OFB or AES-256 encryption key can be created with the KVL 3000 Plus Key Variable Loader as follows:

1. Turn on the KVL 3000 Plus loader.
2. Select **KEYS**.
3. Select **NEW**.
4. At the **CKR** (Common Key References) prompt, enter a number between **00001** and **04095** or between **61440** and **65535**. The entered number must be unique on the loader.
5. Choose **DES-OFB** or **AES-256** as the encryption algorithm.
6. Select **ACCEPT**.
7. Enter a Key Identification (KID) number from **0001** to **FFFF**. The number must be unique for each key of an encryption algorithm in the loader.

NOTE

The XG-100M mobile radio does not support KID number 0000. Attempting to load a key with KID number 0000 from the KVL will result in error message **UNKNOWN ERR CHECK TARGET ALGORITHM!** displayed on the KVL loader. KID number 0000 is reserved for the Suppressed Key feature.

8. Enter a hexadecimal number as the key value. DES-OFB keys are sixteen (16) digits = eight (8) bytes (64 bits). AES keys are sixty-four (64) digits = 32 bytes (256 bits). Odd parity checks are made between every two digits for DES-OFB keys. Parity checks are not made for AES-256 keys.
9. When the loader displays **SLOT FILLED**, press **ENTER**. When the loader finishes creating the key, **KEY WAS SUCCESSFULLY CREATED** displays.
10. Refer to Section 10.6.2.3 for instructions on loading the key into a radio.

10.6.2.2 Creating a Type-3 Encryption Key Group

A group of Type-3 encryption keys can be generated with the KVL 3000 Plus Key Variable Loader as follows:

1. Turn on the KVL 3000 Plus loader.
2. Select **Esc**.
3. Select **GROUPS**.
4. Select **NEW**.
5. Enter a group name (up to 7 characters).

6. Select CKRs from the programmed list until all desired CKRs are selected
7. Select **DONE**.
8. Refer to Section 10.6.2.3 for instructions on loading the key group into a radio.

10.6.2.3 Loading Keys from the Motorola KVL 3000 Plus Loader

To load keys from the KVL 3000 Plus Key Variable Loader to a radio with a CH-100 control head, follow this procedure:

1. Turn on the KVL 3000 Plus loader.
2. Verify valid keys have been created and stored in the loader. If not, see Section 10.6.2 on page 52.
3. Obtain KVL-3000+ Programming Cable 12099-0410-A1. See Table 8-3 on page 29 for the respective catalog number.
4. Mate the cable's microphone-type connector to the mic connector of the control head, and then gently tighten the thumbscrew. Do not over-tighten the thumbscrew.
5. Once the KVL 3000 Plus loader is connected, a keyset is established whether keys are loaded or not, and the keys must be zeroized. Refer to Section 10.6.3.3 on page 54 as necessary. **KEY FILL PROGRESS** is displayed, indicating readiness to accept encryption keys from the loader.
6. At the loader, select **TARGET**.
7. Select **LOAD**.
8. Select **KEY**.
9. Use the loader's ◄ or ►button to select a DES-OFB or AES-256 key.
10. Select **LOAD**.
11. Verify the loader displays **LOADED SUCCESSFULLY OK**.
12. Select **OK** on the loader.
13. To load additional keys, repeat from step 6.
14. Disconnect the loader from the control head.

10.6.2.4 Loading Key Groups from the Motorola KVL 3000 Plus Loader

Load key groups from the KVL 3000 Plus Key Variable Loader to the radio with a CH-100 control head as follows:

1. Turn on the KVL 3000 Plus loader.
2. Verify valid key groups have been created and stored in the loader. If not, see Section 10.6.2 on page 52.
3. Obtain KVL-3000+ Programming Cable 12099-0410-A1. See Table 8-3 on page 29 for the respective catalog number.
4. Mate the cable's microphone-type connector to the mic connector of the control head, and then gently tighten the thumbscrew. Do not over-tighten the thumbscrew.
5. Once the KVL 3000 Plus loader is connected, a keyset is established whether keys are loaded or not, and the keys must be zeroized. Refer to Section 10.6.3.3 on page 54 as necessary.

KEY FILL PROGRESS is displayed at the radio, indicating it is ready to accept encryption keys from the loader.

6. At the loader, select **TARGET**.
7. Select **LOAD**.
8. Select **GROUP**.
9. Use the loader's ◄ or ►button to select a DES-OFB or AES-256 key group.
10. Select **LOAD**.
11. Verify the loader displays **LOADED SUCCESSFULLY OK**.
12. Select **OK** on the loader.
13. To load additional key groups, repeat from step 6.
14. Disconnect the loader from the radio.

10.6.3 Zeroing Keys

10.6.3.1 Zeroing Keys from the CH-100 Control Head

Follow this procedure to zero all encryption keys and keysets stored in the radio. This action also removes all keysets stored in the radio:

1. From the control head's main menu, touch **SECURITY**.
2. Touch **ZEROIZE KEYS**.
3. Confirm by touching **YES**. All encryption keys and keysets stored in the radio are immediately deleted from the radio.

NOTE

After manually zeroing keys, it is recommended to wait at least two (2) minutes before loading new keys into the radio. If an error message is received after attempting to load keys after zeroing, cycle radio power and try again.

10.6.3.2 Zeroing Keys from the CH-721 Control Head

Follow this procedure to zero all encryption keys and keysets stored in the radio. This action also removes all keysets stored in the radio:

1. Press and hold the Clear button (**CLR** on the System model control head; **CLEAR** on the Scan model control head).
2. While depressing the Clear button, press and hold the Option button (**OPT** on the System model control head; **OPTION** on the Scan model control head) for approximately two seconds. Afterwards, a series of warning beeps begins. After the keys have been zeroed, a long tone sounds and the display indicates **KEY ZERO**.

10.6.3.3 Zeroing Keys from the Motorola KVL 3000 Plus Key Variable Loader

Zero (remove) keys and/or key groups from the radio using the KVL 3000 Plus Key Variable Loader, following this procedure:

1. Turn on the KVL 3000 Plus loader.
2. Obtain KVL-3000+ Programming Cable 12099-0410-A1. See Table 8-3 on page 29 for the respective catalog number.

3. Mate the cable's microphone-type connector to the mic connector of the CH-100 control head, and then gently tighten the thumbscrew. Do not over-tighten the thumbscrew.
4. At the loader, select **TARGET**.
5. Select **ZERO**.
6. To zero a single key, select **KEY**.

   To zero a key group, select **GROUP**.

   To zero all keys, select **ALL**.
7. If **ALL** was selected in the previous step, select **YES** to confirm, and skip to step 10.
8. Use the loader's ◄or ►button to select the key/key group to be removed from the radio.

NOTE

The selected key/key group will be deleted from all keysets in the radio.

9. Select **ZERO**.
10. Verify the loader displays **ZEROIZED SUCCESSFULLY OK**.
11. Select **OK** on the loader.
12. To zero additional keys or key groups, repeat from step 4.
13. Disconnect the loader from the radio.
14. If all keys were zeroed, all keys were removed from the radio, but keysets remain in it. In this case, perform a zeroize operation at the radio per the respective procedure in Section 10.6.3.

11. SERVICE INFORMATION

11.1 GENERAL INFORMATION

The Unity XG100M mobile radio, under warranty, **must** be serviced by a service center authorized by L3Harris Technologies. Service performed by any non-authorized service center and/or any non-authorized personnel will void the radio's warranty.

Technicians servicing this radio must isolate the problem to either a hardware or a software problem. Hardware repair of this radio is limited. Radio problems resulting from software errors can usually be corrected by reloading the radio's personality/mission plan and/or flash code, or by re-configuration.

Improperly servicing the radio may void its RF integrity and cause it to violate FCC rules and regulations. Do not service this radio unless it can be fully tested as described in this manual.

For technical assistance, contact the Technical Assistance Center using the contact information listed in Section 7.

11.2 GENERAL GUIDELINES ON CARING FOR THE RADIO EQUIPMENT

- Keep the exterior of the radio, control head, antenna, and radio accessories clean. To remove dust and dirt, use a soft clean damp cloth. Also use mild soap if necessary.
- To ensure efficient operation of the radio's transceiver, always verify antenna connections are tight. If found loose, disconnect and clean connector contacts with a small clean soft-bristle non-metallic brush, then re-connecting and securely tighten.
- To ensure proper operation of accessories connected to the radio, verify the respective electrical contacts are free of dust and dirt before mating the connectors. If necessary, before mating, clean these contacts with a small clean soft-bristle non-metallic brush.

Do **not** use alkaline, alcohol, or petroleum-based cleaners to clean the radio equipment. Use a clean soft damp cloth with a mild soap for cleaning.

11.3 PREVENTIVE MAINTENANCE

11.3.1 General Preventive Maintenance

Preventive maintenance on the radio and accessories should be performed periodically. L3Harris recommends performing preventive maintenance on an annual basis or more often in harsh environments such as an installation in a fire truck. Preventive maintenance includes but is not limited to:

- Cleaning the radio and its accessories in accordance with the guidelines presented in Section 11.2.
- Inspecting the general condition and operation of the controls and keys/buttons of the control head. Inspection included checking for any bent control shaft. Repair or replace, as necessary.

- Inspecting all control head related hardware to verify it is in place and securely tight. Replace and/or tighten any missing or loose hardware, as necessary.
- Inspecting the control head's display for proper operation and/or any cracks or other damage. If any are found, replace the control head, or return it to L3Harris for repair.
- Checking the microphone for proper operation. Repair or replace, as necessary.
- Inspecting all cabling to verify it is not damaged, it is securely tied-and-stowed, and all related cable connectors are tight. Replace, as necessary.
- Inspecting the radio installation's antenna(s) for any damage. If any significant damage is found, replace it with a new antenna. Do **not** attempt to repair a damaged antenna.
- Performing radio and antenna system performance tests as described in the radio's Installation Manual. Repair, as necessary.
- Performing scheduled tests as outlined in the table in Section 11.3.2.
- Verifying overall radio operation by performing an operations check. Correct any found problems, as necessary.

11.3.2 Maintenance Schedule of Basic Radio Measurements

Perform scheduled maintenance tests at the periods listed in the following, or as required per local directives.:

Table 11-1: Maintenance Schedule of Basic Radio Measurements

TEST/MEASUREMENT	SCHEDULE PERIOD	APPLICABLE SECTIONS (PAGE)
		TEST
Reference Oscillator (TCXO)	• Immediately if unit was in storage for at least two (2) months; and, • Six (6) months after first deployment; then, • Annually	11.4.7.1 (64)
Transmit Power	Annually	11.4.7.3 (69)
Transmit Deviation, Analog	Annually	11.4.7.4 (71)
Transmit Deviation, P25/C4FM	Annually	11.4.7.6 [with CH-100 Control Head] (75) 11.4.7.7 [with CH-721 Control Head] (77)
Receive Sensitivity, Analog	Annually	11.4.8.2 (80)
Receive Squelch, Analog	Annually	11.4.8.3 (81)

11.4 RF PERFORMANCE TESTS

11.4.1 General Information

Tests presented in this section are the minimum tests to verify the radio can communicate with another radio in conventional non-trunking mode. These tests do not verify communication systems protocols and/or user-configurable parameters. The procedures developed by the field technician to test the programmed parameters of the radio depend on knowledge and skills obtained from the communication system manuals, training, and experience. If one has questions or needs clarification of observations, please contact the responsible personnel. The order of contact is the communications systems responsible person, the local L3Harris service provider, then L3Harris Technologies via the L3Harris Technical Assistance Center.

Performance test procedures for a complete mobile radio installation are included in the radio's *Installation Manual*, publication number 14221-1200-4440. Those test procedures test basic aspects of the radio and control head installation, including the installation's transmit/receive antenna system.

Improperly servicing the radio could void its RF integrity and cause it to violate FCC rules and regulations. Do not service this radio unless it can be fully tested as described in this manual.

For technical assistance, contact the Technical Assistance Center using the contact information listed in Section 7.

Observe precautions for damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**). Always use proper grounding techniques (wrist or waist straps with grounding cords, grounded table-top mats, etc.) and other approved methods to minimize the chance of damage from ESD.

11.4.2 Minimum Qualifications of the Service Technician

Test procedures that follow assume the service technician meets the following qualifications:

- Is familiar with the operation of the utilized RF communications test set.
- Has knowledge of the safety issues dealing with the shelf-protection, the test equipment, and the radio equipment being tested.
- Is familiar with the operation of the Unity XG-100M mobile radio. Consult the operator's manual for radio user operation during tests.
- Has knowledge and experience in performing standard tests on mobile radios.
- Has knowledge and experience in creating and programming a personality/mission plan into a radio.

11.4.3 Test Equipment

Table 11-2 lists test equipment required for Unity XG-100M mobile radio tests and alignments covered in this section.

NOTE

The utilized RF Communications Test Set should have a frequency accuracy/stability equal to or better than 0.05 ppm. If not, an external timebase reference which meets or exceeds this specification must be applied to the test set's external timebase reference input.

Table 11-2: Test Equipment for Tests and Alignments

EQUIPMENT TYPE	TYPE/MODEL NUMBER(S)
RF Communications Test Set	Aeroflex 2975 or Aeroflex 3920 or Aeroflex 3500 (or equivalent) See important **NOTE** above!
RF Cable, 50-Ohm: TNC Male to Type-N Male	Pasternack Enterprises PE3661-36 (or equivalent)
RF Cable, 50-Ohm: Type-N Male to Type-N Male*	Pasternack Enterprises PE3441-36 (or equivalent)
RF Attenuator, 50-Ohm: 30 dB, Type-N Female*	Bird Tenuline® 100-SA-FFN-30 or 100-A-FFN-30 (or equivalent)
BNC Male-to-BNC Male Coax Cable** (36 inches long)	Pasternack Enterprises PE3067-36 (or equivalent)
Power Supply	Adjustable Regulated DC-Output Power Supply capable of adjustment from 12 to 15 Vdc (minimum adjustment range); 30-ampere (minimum)
Digital Multimeter with Probes	Fluke 87-Series (or equivalent)
Radio Programming Software	Radio Personality Manager (RPM) (See Table 8-3 on page 30 for the RPM release required.)
USB Programming Cable (if equipped with CH-100)	L3Harris Part Number W95-0011-302
Serial Programming/Data Cable (if equipped with CH-721)	L3Harris Part Number CA-104861 or CA-013671-020
Personal Computer (PC)	Laptop or desktop PC which meets or exceeds minimum requirements of RPM Release R7A or later or RPM2 Release R3A or later. Refer to *Software Release Notes* MS-012550-001 or *Software Release Notes* 14221-1100-8170 for additional information.
Modified Microphone	L3Harris Part Number MC-101616-040 or MC-101616-041 modified similar to Tech Tips modification instructions in the Technical Training Toolbox on the Tech Link web site (https://premier.pspc.harris.com/infocenter/TechLink). See Tech Tips Issue 4 — *Interfacing for Audio Testing*.

Table 11-2: Test Equipment for Tests and Alignments

EQUIPMENT TYPE	TYPE/MODEL NUMBER(S)
Modified Speaker	L3Harris Part Number LS102824V10 modified similar to Tech Tips modifications instructions in the Technical Training Toolbox on the Tech Link web site (https://premier.pspc.harris.com/infocenter/TechLink). See Tech Tips Issue 4 — *Interfacing for Audio Testing*.
DC Power Cable with Fuses (for Powering Radio)	L3Harris Part Number CA-012365-001
DC Power Cable with Fuses (for Powering Control Head)***	L3Harris Part Number CA-012616-001
CAN Cable***	L3Harris Part Number CA-009562-006 (6 feet long) or CA-009562-030 (30 feet long)
CAN Terminators (2)	L3Harris Part Number CD-014027-001
Speaker Cable***	L3Harris Part Number MAMROS0034-NN006
Option Cable****	L3Harris Part Number 14002-0174-01 (formerly CA-012349-001)

* An RF attenuator is required if the utilized RF Communications Test Set does not have a high-power input port capable of at least 50 watts of continuous RF input power.

** Not required to perform the following tests/alignment: Transmitter Frequency Test, Transmitter Frequency Alignment, Transmitter Power Levels Test, Transmitter P25 (C4FM) Modulation Pattern Test, and Receiver P25 (C4FM BER) Sensitivity Test.

*** Not required for testing a front-mount radio.

**** Not required for testing a remote-mount radio.

NOTE

Test procedures included in this section can be performed on customer frequencies/channels, if possible. This will prevent unnecessary radio personality reprogramming operations.

However, if customer frequencies/channels are not available and/or the utilized test equipment does not allow testing on these frequencies/channels or radio operating mode, create a conventional test personality and use as described in the following section.

11.4.4 Recommended Conventional Test Personality/Mission Plan

To create a conventional test personality/mission plan for XG-100M radio testing, use RPM to create and program one into the radio as follows. Also refer to Section 10.4 and/or RPM's online help as necessary:

Create the Analog Conventional Test System:

1. Create a new conventional system using RPM's **Add New System** button. This button is located on the **System Setup** dialog box's **General** tab.
2. Configure this new conventional system with at least the analog conventional test channels listed in Table 11-3. Achieve this by creating a new conventional (channel) set with the listed channels and assigning the set to the new system. Radio frequencies can be changed to compensate for any local RF interference.

3. CH-100 Control Head Only: Use the **Unity Mobile Options** dialog box to enter a **Maintenance Password**. Access this dialog box by double-clicking on **Unity XG100 Mobile Options** in the **Options** limb of RPM's **Personality Data Tree**. **Make a note of the entered maintenance password for later use.** If required, this password allows performance of several P25 (C4FM) related tests at the radio.
4. CH-100 Control Head Only: In this dialog box, enter a **Channel Edit Password**. At the radio, this password will allow editing of a channel's programmed parameters, such as transmit frequency, receive frequency, transmit power level, etc. **Make a note of this password for future use.**

   The **User UI Privilege Level** defaults to **Full**. This setting should not be changed.
5. CH-100 Control Head Only: Click the **OK** button to exit this dialog box.

Table 11-3: Analog Conventional and P25 Conventional Test Channels for Test Personality/Test Mission Plan

TX FREQ. (MHz)	RX FREQ. (MHz)	TX POWER	RECOMMENDED LONG NAMES*		RECOMMENDED SHORT NAME		TX AND RX CG	BAND-WIDTH
			FOR ANALOG SYSTEM	FOR P25 CONV. SYSTEM	FOR ANALOG SYSTEM	FOR P25 CONV. SYSTEM		
136.000	136.000	Low	136 MHZ ANALOG	136 MHZ P25C	136MHZ_AN	136MHZ_P	None	"Narrow" (12.5 kHz) for Analog Conventional System; "C4FM" (12.5 kHz) for P25 Conventional System
174.000	174.000	Low	174 MHZ ANALOG	174 MHZ P25C	174MHZ_AN	174MHZ_P	None	
380.000	380.000	Low	380 MHZ ANALOG	380 MHZ P25C	380MHZ_AN	380MHZ_P	None	
520.000	520.000	Low	520 MHZ ANALOG	520 MHZ P25C	520MHZ_AN	520MHZ_P	156.7 Hz	
794.0125	764.0125	Low	TX794 RX764 ANA	TX794 RX764 P25C	RX764_AN	RX764_P	None	
869.9875	869.9875	Low	870 MHZ ANALOG	870 MHZ P25C	870MHZ_AN	870MHZ_P	None	

* Long names apply to the CH-100 control head only. A long name cannot be entered in an RPM frequency set in a personality for the XG-100M with a CH-721.

6. In the **System Setup** dialog box, click the **General** tab, then click the **TX Power Levels** button. This opens the **XG100M TX Power Levels** dialog box, as shown in Figure 11-1.
7. Verify all four RF bands have their high and low limits set as shown in Figure 11-1. If not, make the necessary change(s).
8. Exit this dialog box and save changes by clicking the **OK** button.
9. CH-721 Control Head Only: In the **Personality Data Tree**, expand **Options**, double-click on **Programmable Menus** and then use that dialog box to set the **TX POWER** function as one of the twenty selections on the conventional menu. This function is necessary for the Transmitter Performance Tests in Section 11.4.7.
10. CH-721 Control Head Only: Add the **SQUELCH** function as one of the twenty selections on the conventional menu. This function is necessary for the Receiver Performance Tests in Section 11.4.8.
11. CH-721 Control Head Only: Add the **FCC MENU** function as one of the twenty selections on the conventional menu. This function is necessary for P25-related test procedures.

12. CH-721 Control Head Only: Add the **CG SEL** function as one of the twenty selections on the conventional menu. This function is necessary for the Receiver CTCSS/CDCSS Decode Test in Section 11.4.8.4.
13. Continue by creating a new P25 test system.

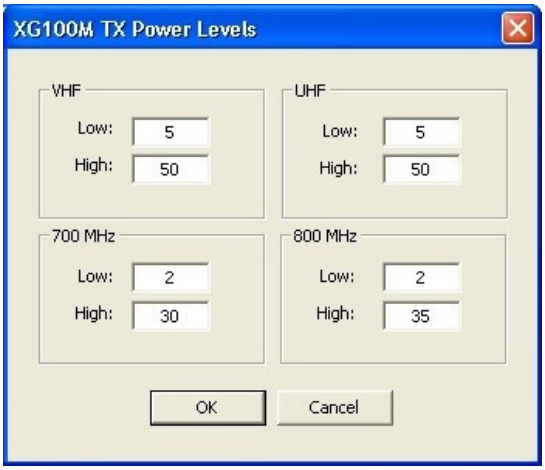


Figure 11-1: XG-100M Tx Power Levels Dialog Box with Required Settings

Create the P25 Conventional Test System:

14. Create a new P25 conventional system using RPM's **Add New System** button.
15. Configure this new P25 conventional system with at least the P25 conventional test channels listed in Table 11-3. Achieve this by creating a new P25 conventional (channel) set with the listed channels and assigning the set to the new system.
16. Set each P25 test channel's **Voice Mode** to **P25** and **Bandwidth** to **C4FM**.
17. Set each channel's **Tx NAC** and **Rx NAC** as desired or leave them at the default values of **293**.
18. In the **System Setup** dialog box's **Project 25 Conventional** tab, set the radio's **Unit ID** number as required (range = 1 to 9,999,999 decimal).

Save and Program Radio:

19. Save this personality and program it to the radio. Refer to Section 10.4 and/or RPM's online help as necessary.

11.4.5 Bench Setup

This bench setup procedure is required by several test procedures that follow:

1. Power-up all test equipment and allow at least a 30-minute warm-up time.
2. With the power supply's output **off**, connect the radio and control head to this output. To make these connections, use standard DC power installation cables with standard fuses and fuse holders, and proceed as follows:
   - **To Connect the Radio to the Power Supply:** Use cable CA-012365-001 with a 20-amp fuse in its red wire (main power) to the power supply's positive (+) output terminal. Connect the cable's black wire to the power supply's negative (-) output terminal. For a remote-mount radio, leave the cable's white wire unconnected and insulated. For a front-mount radio, connect the white wire (ignition sense input) via a 3-amp fuse to the power supply's positive (+) output terminal or to a switched power source.

- **Remote-Mount Radio Only — To Connect the Control Head to the Power Supply:** Use cable CA-012616-001 with a 5-amp fuse in the red wire (main power) to the power supply's positive (+) output terminal. Connect the cable's black wire to the power supply's negative (-) output terminal. Connect the cable's white wire to the power supply's positive output terminal with a 3-amp fuse in the white wire (switched power).

CAUTION

Always observe polarity when making connections to the power supply!

3. **Remote-Mount Radio Only:** Connect a CAN cable between the control head and the radio.
4. **Remote-Mount Radio Only:** Terminate both ends of the CAN link by installing a CAN terminator onto each unterminated CAN port connector. Install one terminator at the radio and one terminator at the control head. For a front-mount radio, install two terminators on the back of the radio.
5. **Front-Mount Radio Only:** Install a CAN terminator on one of the two CAN port connectors on the rear of the radio.
6. Connect the radio's TNC antenna port connector to the RF Communications Test Set's T/R port. To make this connection, use only high-quality RF coax cable(s).

NOTE

If the utilized test set does not have a T/R port capable of at least 50 watts of continuous RF power, use an external RF attenuator between the radio and test set. The attenuator should have a minimum power rating of 60 watts. If an external attenuator is used, all RF signal level measurements must be adjusted accordingly when making RF signal level measurements.

7. Obtain/Construct the modified speaker. See Table 11-2 for additional information.
8. Obtain/Construct the modified microphone. See Table 11-2 for additional information.
9. **Remote-Mount Radio Only:** Use 6-inch Speaker Cable MAMROS0034-NN006 to connect the modified speaker to the speaker connector (labeled **AUDIO**) on the rear of the control head. Mate the cable's 2-pin circular connector to the connector on the rear of the control head, and then mate the cable's 2-pin rectangular connector to the cable of the modified speaker.
10. **Front-Mount Radio Only:** Use Option Cable 14002-0174-01 (formerly CA-012349-001) to connect the modified speaker to the radio. Mate the cable's 44-pin connector to the 44-pin connector on the rear of the radio, and then mate the option cable's 2-pin speaker connector to the 2-pin speaker connector of the modified speaker's cable.
11. Connect the modified microphone to the control head's front panel mic connector.
12. Set the DC power supply's output voltage to 13.8 Vdc with a current limit between 20 and 25 amps. This voltage allows a 0.2-volt drop for the leads of the radio's DC power cables, at maximum current demand.
13. Turn on the radio and the control head and allow at least a 20-minute warm-up period.

11.4.6 Synthesizer Performance Test

This test verifies the lock range of the radio's synthesizer circuits and it allows additional time for the temperature of the radio to stabilize.

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select the 136.000 MHz analog conventional test channel.

NOTE

Setting the RF communications test set's RF signal generator on-frequency is **not** necessary when performing this procedure. The test set's T/R port is used as a 50-ohm load for the radio's antenna port.

3. Wait at least two (2) seconds.
4. Verify an alarm message is not displayed at the control head. In this case, receiver synthesizer lock is confirmed.
5. Key the radio by depressing the modified microphone's PTT button and verify it is transmitting. On the CH-100 control head, the red transmit forward power icon ( ) appears in the display. On the CH-721 control head, the Tx/Busy indicator lights red.
6. Verify an alarm message is not displayed at the control head. In this case, transmit synthesizer lock is confirmed.
7. Unkey the radio.
8. Repeat the previous steps on at least all test channels listed in Table 11-3. The lack of an alarm message on all listed channels verifies the radio's synthesizer can lock at each end of each RF band, transmit and receive.
9. Record test results in Table 11-4.

Table 11-4: Synthesizer Performance Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

NOTE

Failure on any channel, receive or transmit, indicates a defect in the radio. In this case, the radio must be returned to L3Harris for service!

11.4.7 Transmitter Performance Tests

11.4.7.1 Transmitter Frequency and TCXO Frequency Test

Use the procedures in this section to test the XG-100M radio's transmitter frequency. An alignment procedure for the radio's Temperature-Compensated Crystal Oscillator (TCXO) is included in the next section. TCXO frequency affects both transmitter and receiver performance.

Prior to testing and/or alignment, review the following information and follow to ensure accuracy and tolerance are maintained, as well as unnecessary adjustments are not performed.

NOTE

The radio's TCXO is a highly accurate and stable crystal reference oscillator which should **not** normally require re-alignment. The use of a recently calibrated RF Communications Test Set or Frequency Counter is recommended. **The utilized test equipment should have a specified frequency accuracy/stability equal to or better 0.05 ppm.**

NOTE

Perform this test with the radio and test equipment at room temperature between 68 and 77° Fahrenheit (20 to 25°C).

Operation in a P25 system and narrowband analog systems requires a tighter frequency specification than those of previous type analog radio systems. The UHF and 700 MHz bands have tighter requirements than other bands. However, the use of P25 puts the same channel requirements across the bands. The technician must be diligent when making frequency measurements, and even more so when frequency alignment is required. For field-grade measurements/tests, it is acceptable to use test equipment with a maximum frequency error that is only five (5) times better the radio equipment being tested. However, when adjustments are needed, lab-grade test equipment with a maximum frequency error that is at least ten (10) times better than the radio is recommended.

Before adjusting, check the timebase of the RF communications test set or counter against another known good standard, or have the test equipment utilize an external high stability frequency standard stabilized by GPS satellite reception.

Maximum errors for the test frequencies are stated in Table 11-5. When testing, the errors stated for ±0.5 ppm will compensate for equipment errors, as well as the temperature curve of the radio's reference oscillator. With lab-grade test equipment, errors in the ±0.25 ppm range are expected for room temperature. If frequency alignment is necessary, maximum errors in the ±0.1 ppm range should be used for alignment. As a reminder, if alignment is necessary, use a calibrated ±0.05 ppm timebase and measurement resolution to the nearest Hz.

Follow this test procedure:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. CH-100 Control Head Only: Select the test personality/mission plan via the **PROGRAM** menu.
3. Select the analog conventional test zone/system.
4. Select an analog conventional test channel that does not have any signaling modulation, such as CTCSS (Channel Guard) or CDCSS (Digital Channel Guard).

CAUTION

If the 520 MHz analog conventional test channel is selected, disable the CTCSS tone before making any transmitter frequency measurement. This is accomplished via the **EDIT CHAN** soft-key and the Maintenance Password set for the current personality/mission plan.

5. Configure the RF communications test set to measure the transmit frequency.

Table 11-5: Maximum Transmit Frequency Errors for Recommended Test Channels

TEST TX FREQUENCY (MHz)	MAXIMUM TRANSMIT FREQUENCY ERROR (Hz)	MINIMUM TX FREQUENCY (MHz)	MAXIMUM TX FREQUENCY (MHz)
±0.5 ppm Error Across the Temperature Range of -4 to +140° Fahrenheit (-20 to +60° Celsius)			
136.000	±68 Hz	135.999932	136.000068
174.000	±87 Hz	173.999913	174.000087
380.000	±190 Hz	379.999810	380.000190
520.000	±260 Hz	519.999740	520.000260
794.0125	±397 Hz	794.012103	794.012897
869.9875	±435 Hz	869.987065	869.987935
Generally Accepted ±0.25 ppm Error at Room Temperature 68 to 77° F (20 to 25°C)			
136.000	±34 Hz	135.999966	136.000034
174.000	±44 Hz	173.999956	174.000044
380.000	±95 Hz	379.999905	380.000095
520.000	±130 Hz	519.999870	520.000130
794.0125	±199 Hz	794.012301	794.012699
869.9875	±218 Hz	869.987282	869.987718
±0.1 ppm Error at Room Temperature 68 to 77° F (20 to 25°C)			
136.000	±14 Hz	135.999986	136.000014
174.000	±17 Hz	173.999983	174.000017
380.000	±38 Hz	379.999962	380.000038
520.000	±52 Hz	519.999948	520.000052
794.0125	±79 Hz	794.012421	794.012579
869.9875	±87 Hz	869.987413	869.987587

CAUTION

When an antenna is connected to the radio, do **not** transmit on any test frequency unless authorized to do so**.**

6. Key the radio via the modified microphone's toggle switch. Do **not** use the mic's normal PTT button. Also, do **not** apply any signal to the modified mic's BNC connector at this time. These actions ensure the transmitter is not modulated.
7. Verify the radio is transmitting. On the CH-721 control head, the Tx/Busy indicator lights red. On the CH-100 control head, the red transmit forward power icon ( ) appears in the display.
8. Use the test set's frequency counter function to accurately measure the transmit frequency.
9. Record the measured transmit frequency in Table 11-7. Any error outside of the listed limits indicates a possible TCXO or transceiver synthesizer circuit problem.

Table 11-6: Measured Transmit Frequencies for Recommended Test Channels, and Test Results

TEST TX FREQUENCY (MHz)	MAXIMUM TRANSMIT FREQUENCY ERROR (±0.5 ppm)	MINIMUM TX FREQUENCY (MHz)	MAXIMUM TX FREQUENCY (MHz)	MEASURED FREQUENCY (MHz)	PASS/-FAIL
136.000	±68	135.999932	136.000068		
174.000	±87	173.999913	174.000087		
380.000	±190	379.999810	380.000190		
520.000	±260	519.999740	520.000260		
794.0125	±397	794.012103	794.012897		
869.9875	±435	869.987065	869.987935		

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

10. While observing the measured transmit frequency, vary the power supply's output voltage approximately 1.4 volts above and below the 13.8-volt DC setting. Do this several times. The frequency should not change with a voltage change.

NOTE

If the transmit frequency changes because of the power supply voltage change, return the radio to L3Harris for service. If the transmit frequency is out of tolerance, TCXO tuning is necessary, as described in the following section.

11. Unkey the radio.
12. Return the power supply's output voltage to 13.8 volts DC.
13. Change the channel at the control head and repeat the transmit frequency measurements for the other test channels listed in Table 11-6.
14. Record the radio's serial number, the test date, and the technician's initials in the table.
15. If no additional tests will be performed, disconnect all test equipment and remove the conventional test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

CAUTION

Do **not** return the radio to service if any measured frequency exceeds a limit.

11.4.7.2 TCXO Frequency Alignment

Use the following procedure to align the radio's Temperature-Compensated Crystal Oscillator. TCXO frequency affects both transmitter and receiver performance:

NOTE

The radio's TCXO is a highly accurate and stable crystal reference oscillator which should **not** normally require re-alignment. The use of a recently calibrated RF Communications Test Set or Frequency Counter is recommended. **The utilized test equipment should have a specified frequency accuracy/stability equal to or better 0.05 ppm.**

NOTE

Perform this test with the radio and test equipment at room temperature between 68 and 77° Fahrenheit (20 to 25°C).

NOTE

If frequency alignment is necessary, use maximum errors in the ±0.1 ppm range for alignment.

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Connect a PC with a terminal emulation program such as Windows HyperTerminal to the radio's DB-9 serial port connector. Use Serial Programming Cable CA-104861 (5 feet long) or Serial Data Cable CA-013671-020 (20 feet long), or equivalent, to make this connection.

NOTE

If the utilized PC is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232C Adapter Cable CN24741-0001. CN24741-0001 is available via the Customer Care center; refer to Section 6 on page 25 for contact information.

3. At the PC, start the terminal emulation program.
4. Configure the terminal emulation program to use the respective serial communications (COM) port at 19200 bits-per-second, 8 data bits, no parity, 1 stop bit, and no flow control. VT100 or equivalent terminal emulation is recommended. Also, echo of typed characters locally should be turned off, as the radio will echo characters it receives on its serial port.
5. Put the radio into test mode by sending it the following command via the terminal emulation program:

   cmd 0
6. Send the following command to the radio to display the current TCXO alignment value:

   cmd 9 0
7. Make a note of the displayed value (which is displayed as an "AFC" value).
8. Send the following command to the radio to set the transmit frequency to any test transmit frequency:

   cmd 70 <frequency> where <frequency> = The desired Tx Frequency in **Hertz**
   (e.g., **cmd 70 869987500** for 869.9875 MHz)
9. Configure the RF communications test set to measure this frequency.

10. Send the following command to the radio to key it on this frequency:

    cmd 74 1

11. Send the following command to the radio to adjust the TCXO alignment value as required to adjust the measured transmit frequency as close as possible to the set transmit frequency:

    cmd 9 <value> (or **cmd 9 –<value>**) where <value> = TCXO increment or decrement. This number will add to or subtract from the previously read TCXO alignment value.

12. Repeat the previous step as necessary to bring the measured transmit frequency within limits. Ideally, the measured transmit frequency should be within the respective ±0.1 ppm limits listed in Table 11-5. Step resolution of the increment/decrement value may not allow setting to the exact frequency. If so, set the value as close as possible to the programmed transmit frequency.

13. Send the following command to the radio to unkey it:

    cmd 74 0

14. Save the new TCXO alignment value to the radio's non-volatile memory by sending it the following command:

    cmd 29

15. Power-cycle the radio and control head.

16. Repeat the Transmitter Frequency and TCXO Frequency Test in Section 11.4.7.1.

17. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.4.7.3 Transmitter Power Levels Test

The Unity XG-100M radio has multiple transmitter power levels. The radio user can toggle between two (2) user-selectable power levels, high and low. The currently selected channel's present power level is indicated by an icon near the top-center of the control head's display. Two small blue squares indicate high power level and one small blue square indicates low power level.

Figure 11-2: High and Low Transmit Power Level Icons

The actual values of the user-selected transmit power levels are established within the RPM software. To access other levels, it is necessary to reprogram the radio using the **TX Power Levels** button on RPM's **System Setup** dialog box (**General** tab). The values of power are correlated to calibrated points that may be outside of the band of normal frequencies. On some 700 MHz low-power channels, the radio will automatically restrict itself to the low power level. See the FCC Part 90 rules for those channels. Table 11-7 lists the expected power levels and parameters for transmit frequencies at RF band extremes.

Follow this procedure to check the XG-100M radio's transmitter output power levels. These levels are factory-aligned; they cannot be adjusted in the field:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Zero out (i.e., account for) all loss in utilized RF test cable(s), RF attenuator, RF adapter(s), etc. Refer to the RF communications test set's documentation and the equipment's RF loss data, as necessary.
3. CH-100 Control Head Only: Select the test personality/mission plan via the **PROGRAM** menu.
4. Select the analog conventional test zone/system.
5. While in the low transmit power level (per programming specified in Table 11-3), select each conventional test channel, key the radio by depressing the modified microphone's PTT button, and verify the measured transmit output power level is within the respective range listed in listed in Table 11-7. If not, check cable connections, etc., and re-test if necessary. Record measured values in Table 11-7.

Table 11-7: Transmitter Power Test—Maximum Errors, and Test Results

TX POWER LEVEL SETTING AND BAND	TOLERANCE (dB)	LIMITS		MEASURED TX POWER LEVEL (Watts)	PASS/-FAIL
		MINIMUM TX POWER	MAXIMUM TX POWER		
Low (5 watts) on VHF	±0.5 dB	4.45 Watts (36.49 dBm)	5.61 Watts (37.49 dBm)		
High (50 watts) on VHF	±0.25 dB	47.2 Watts (46.74 dBm)	53.0 Watts (47.24 dBm)		
Low (5 watts) on UHF	±0.5 dB	4.45 Watts (36.49 dBm)	5.61 Watts (37.49 dBm)		
High (50 watts) on UHF	±0.25 dB	47.2 Watts (46.74 dBm)	53.0 Watts (47.24 dBm)		
Low (2 watts) on 700 MHz	±0.5 dB	1.78 Watts (32.5 dBm)	2.24 Watts (33.5 dBm)		
High (30 watts) on 700 MHz	+0.1 dB -0.8 dB	25.1 Watts (44.0 dBm)	30.9 Watts (44.9 dBm)		
Low (2 watts) on 800 MHz	±0.5 dB	1.78 Watts (32.5 dBm)	2.24 Watts (33.5 dBm)		
High (35 watts) on 800 MHz	±0.25 dB	33.0 Watts (45.19 dBm)	37.1 Watts (45.69 dBm)		

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

CAUTION

Do **not** return the radio to service if any measured transmit power level is outside of the respective limits listed in Table 11-7.

NOTE

Switching Transmit Power Level from the CH-100 Control Head:

To switch between low-power and high-power transmit level, with a conventional channel selected, touch the **CHANNEL** box near the top of the display. **CHANNEL INFO** displays. Next, touch **EDIT CHAN** (edit channel) and then enter the RPM-established maintenance password. Finally, from the **CHANNEL EDIT** screen, touch **TX POWER** to toggle between the low and high transmit power levels. Touch ← to return to the main menu.

NOTE

Switching Transmit Power Level from the CH-721 Control Head:

To switch between low-power and high-power transmit level, press the CH-721 control head's **MENU** button, then use the •/•• ramp control to scroll through the menu until **TX POWER** appears in the middle line of the display. Finally, toggle to the other power level by pressing the **MENU** button again.

6. Unkey the radio by releasing the PTT button.
7. At the control head, switch the radio to high-power transmit level.
8. While in the high-power transmit level, select each test channel, key the radio by depressing the modified microphone's PTT button, and verify the measured transmit output power level is within the respective range listed in Table 11-7. If not, check cable connections, etc., and re-test if necessary. Record measurements in the table. Be sure to unkey the radio, select a new channel, and switch the power level back to high-power transmit before re-keying.
9. Key the radio on at least one test channel and verify the power supply's output current is below the respective DC supply current requirement specification listed in Section 3.1.
10. Unkey the radio.
11. Repeat until all test channels and power levels are tested and measured.
12. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

11.4.7.4 Transmitter Analog Modulation Tests

The analog tests performed in the following procedure checks the radio's maximum transmit deviation, conventional modulation sensitivity, modulation distortion, modulation limiting, and modulation symmetry. Analog conventional test channels/frequencies are shown in Table 11-8.

NOTE

Before performing this test procedure, the test personality/mission plan must be modified with new frequencies and bandwidth settings shown in the Table 11-8. Deviation limits are different based upon channel bandwidth. Do **not** use the test frequencies listed in Table 11-3 when performing this procedure.

This test also verifies operation of the control head's front panel microphone audio input. To test the control head's internal microphone audio, a sound pressure test box is required, which is beyond the scope of this manual.

Table 11-8: Transmit 60% System Deviations and Maximum Deviations

TEST TX FREQUENCY (MHz)	CHANNEL BANDWIDTH	60% SYSTEM DEVIATION (± kHz Peak)	MAXIMUM DEVIATION (± kHz Peak)
136.025	Wide (25 kHz)	3.0 ±0.1	4.4 ±0.4
	Narrow (12.5 kHz)	1.5 ±0.1	2.2 ±0.2
173.975	Wide (25 kHz)	3.0 ±0.1	4.4 ±0.4
	Narrow (12.5 kHz)	1.5 ±0.1	2.2 ±0.2
380.025	Wide (25 kHz)	3.0 ±0.1	4.4 ±0.4
	Narrow (12.5 kHz)	1.5 ±0.1	2.2 ±0.2
519.975	Wide (25 kHz)	3.0 ±0.1	4.4 ±0.4
	Narrow (12.5 kHz)	1.5 ±0.1	2.2 ±0.2
794.0125	Narrow (12.5 kHz)	1.5 ±0.1	2.2 ±0.2
815.0125	Wide (25 kHz)	3.0 ±0.1	4.4 ±0.4
	NPSPAC	2.4 ±0.1	3.55 ±0.35
860.0125	Wide (25 kHz)	1.5 ±0.1	4.4 ±0.4
	NPSPAC	2.4 ±0.1	3.55 ±0.35

NOTE

Programming each channel for a low transmit power level is recommended.

Follow this test procedure:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select an analog conventional test channel/frequency listed in Table 11-8. It must not have any signaling modulation such as CTCSS (Channel Guard) or CDCSS (Digital Channel Guard).
3. Configure the RF communications test set for an on-frequency FM deviation measurement.
4. Key the radio via the modified microphone's PTT button and speak into the microphone.
5. Verify the test set indicates the radio is transmitting.
6. For the CH-100 control head, use a finger to cover the internal microphone port on the front panel of the control head.
7. Using the test set's oscilloscope, verify voice audio from the modified microphone is modulating the transmitter.
8. Unkey the radio.
9. Key the radio via the modified microphone's toggle switch. Do **not** use the mic's normal PTT button. Also, do **not** apply any signal to the modified mic's BNC connector at this time. These actions ensure the transmitter is not modulated.

10. Verify the test set indicates the radio is transmitting but without voice deviation.
11. Unkey the radio.
12. Set the digital multimeter to measure volts and then connect its negative (black) lead to the base of the modified microphone's female BNC connector.
13. Gently touch the multimeter's positive (red) lead to the center conductor of this BNC connector.
14. Verify the multimeter indicates 9.0 ±1.0 volts DC. This is the (unloaded) DC bias voltage from the control head for the externally connected mic.
15. Disconnect the multimeter's leads.

NOTE

If this DC bias voltage affects the RF communications test set's audio function generator during TX audio tests, a series-connected 150 µF capacitor will need to be added in the audio connection between the test set and the modified microphone.

16. Using a suitable test cable, connect the test set's audio output port to the female BNC connector on the modified microphone. Typically, a BNC male-to-BNC male coax cable can be used.
17. Configure the RF communications test set to provide a 1 kHz tone to the modified microphone, at a level of 85 mV rms.
18. Key the radio via the modified microphone's toggle switch.
19. At the test set, verify the radio is transmitting and it is being modulated by the 1 kHz tone from the test set.
20. Adjust the level of the 1 kHz tone to produce the 60% deviation level for the channel. See Table 11-8. The level should be between 50 and 120 mV rms.
21. Using the test set's oscilloscope, observe the demodulated audio. It should be a clean sine wave free of observable noise and/or any distortion.
22. Use the test set's distortion meter to measure the distortion of the demodulated audio. It should be less than 1.25%. Measuring distortion on other test channels/frequencies is not necessary.
23. Increase the 1 kHz tone by 20 dB (i.e., increase the test set's audio output voltage level by 10 times).
24. Verify the measured deviation is within the respective Maximum Deviation limits listed in Table 11-8. For example, for the 136.025 MHz wide band test channel, the deviation should be between 4.0 and 4.8 kHz.
25. Verify the demodulated audio waveform at the test set is a clean sine wave with no signs of limiting.
26. Using the test set's audio deviation meter, compare the positive peak deviation to negative peak deviation. The difference should not exceed 100 Hz.
27. Unkey the radio.
28. Repeat this test for all test channels/frequencies listed in Table 11-8.
29. Record test results in Table 11-9.

Table 11-9: Transmitter Analog Modulation Tests Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

30. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan must be removed from the radio before it is returned to normal service; see Section 10.4.4 on page 46 for details.

CAUTION

Do **not** return the radio to service if any measured parameter exceeds the respective limits.

11.4.7.5 Transmitter CTCSS/CDCSS Modulation and Composite Deviation Tests

Follow this test procedure to verify Continuous Tone-Coded Squelch System (Channel Guard) and Continuous Digital-Coded Squelch System (Digital Channel Guard) encode operation. Parameters tested include deviation of each type of system for each channel bandwidth, the frequency of CTCSS tone generated by the radio, the accuracy of the generated CDCSS code, and the composite deviation with voice test tone applied. It is assumed the technician has knowledge of CTCSS tone frequencies and CDCSS codes. Table 11-10 gives the limits for the tests.

Table 11-10: Transmit CTCSS/CDCSS and Composite Deviations

CHANNEL BANDWIDTH	CTCSS/CDCSS DEVIATION (± kHz Peak)	COMPOSITE DEVIATION (± kHz Peak)
Wide (25 kHz) 150 MHz, 450 MHz, 800 MHz	0.5 – 1.0	4.0 – 4.8
Narrow (12.5 kHz) 150 MHz, 450 MHz, 700 MHz	0.35 – 0.5	2.0 – 2.4
NPSPAC (25 kHz) 800 MHz	0.4 – 0.8	3.2 – 3.9

1. Complete the Transmitter Analog Modulation Tests procedure in Section 11.4.7.4.
2. Select any analog conventional channel with CTCSS tone or CDCSS code enabled. Alternately, select a channel without CTCSS/CDCSS then use the CH-100 control head's **EDIT CHAN** (edit channel) function to set a CTCSS tone or CDCSS code.
3. Configure the RF communications test set on-frequency and set it to measure the expected demodulated CTCSS/CDCSS tone/code.
4. Disconnect any signal applied to the modified microphone's BNC connector.
5. Key the radio via the modified microphone's toggle switch.
6. Using the test set, measure the deviation and demodulated CTCSS tone frequency or CDCSS code. The deviation should be within the limits stated for CTCSS/CDCSS deviation in Table 11-10. Also, the tone/code should be the tone/code programmed into the radio for this test channel (or set via the **EDIT CHAN** function). For CTCSS, the measured tone frequency should be within ±0.25 Hz of the programmed CTCSS tone frequency.

7. Unkey the radio.
8. Using a suitable test cable, connect the test set's audio output port to the female BNC connector on the modified microphone. Typically, a BNC male-to-BNC male coax cable can be used.
9. Configure the test set to provide a 1 kHz tone to the modified microphone, at a level of 85 mV rms.
10. Key the radio via the modified microphone's toggle switch.
11. Using the test set, measure the deviation and demodulated CTCSS tone frequency or CDCSS code. The deviation should be within the limits stated for composite deviation in Table 11-10. Also, the tone/code should be the tone/code programmed into the radio for this test channel.
12. Unkey the radio.
13. Repeat tests on at different channel bandwidths per Table 11-10, with different CTCSS tones, and different CDCSS codes.
14. Record tests results in Table 11-11.

Table 11-11: Transmitter CTCSS/CDCSS Modulation and Composite Deviation Tests Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

15. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio before it is returned to normal service; see Section 10.4.4 on page 46 for details.

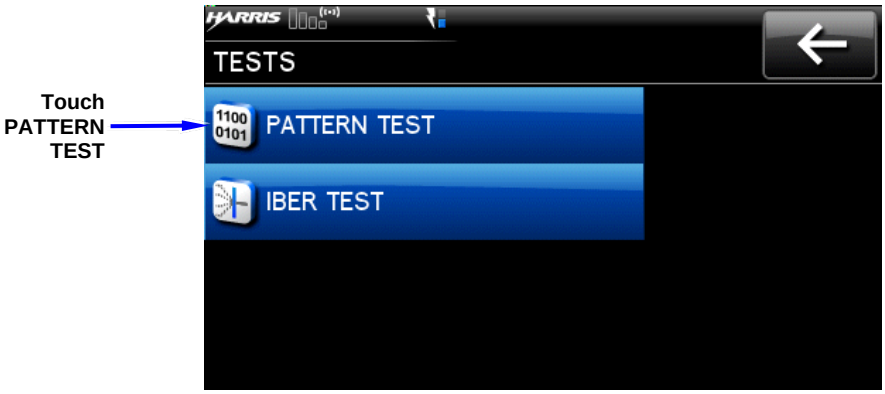
11.4.7.6 Transmitter P25 (C4FM) Modulation Pattern Test with CH-100 Control Head

Follow this procedure to check the transmit P25 (C4FM) modulation performance of the XG-100M radio with a CH-100 control head:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select the P25 conventional test zone/system and select any test channel in that zone/system programmed for P25 (C4FM) operation. Refer to Table 11-3 as necessary.
3. Configure the test set for an on-frequency peak positive FM deviation measurement.
4. Configure the test set deviation meter's audio bandwidth response with a high-pass frequency at $\leq$ 15 Hz and low-pass frequency at $\geq$ 3 kHz.
5. Disable the deviation meter's de-emphasis function.

6. In the radio's **UTILITIES** menu, touch **TESTS**. If this selection is not available (i.e., if it is dimmed-out), the currently selected channel is not programmed for P25 (C4FM) operations.

7. When prompted, enter the password, and then touch **OK**. The password is the **Maintenance Password** defined in the personality/mission plan.
8. Touch **PATTERN TEST**.



The **TX PATTERN** screen displays, as shown below.

9. Verify the radio's antenna port is properly terminated (i.e., connected to the test set's T/R port).
10. Touch **C4FM HIGH PAT**.

Upon selection, the radio immediately begins transmitting, as indicated by the red transmit forward power icon ( ) in the display. The transmitted pattern is a standard C4FM high symbol rate pattern.

11. Verify the deviation measured by the test set is between 2545 and 3111 Hz.

12. Touch **STOP TEST**. The radio stops transmitting.
13. Touch **TX PATTERN** again.
14. In the pop-up menu, scroll down and touch **C4FM LOW PAT**. Upon selection, the radio immediately begins transmitting, as indicated by the red transmit forward power icon ( ) in the display. The transmitted pattern is a standard C4FM low symbol rate pattern.
15. Verify the deviation measured by the test set is between 849 Hz and 1037 Hz.
16. Touch **STOP TEST** again. The radio stops transmitting.
17. Record test results in Table 11-12.

Table 11-12: Transmitter P25 (C4FM) Modulation Pattern Test with CH-100 Control Head Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

18. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio before it is returned to normal service; see Section 10.4.4 on page 46 for details.

11.4.7.7 Transmitter P25 (C4FM) Modulation Pattern Test with CH-721 Control Head

Follow this procedure to check the transmit P25 modulation performance of the XG-100M radio with a CH-721 control head:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select the P25 conventional test zone/system and select any test channel in that zone/system programmed for P25 (C4FM) operation. Refer to Table 11-3 as necessary.
3. Configure the test set for an on-frequency peak positive FM deviation measurement.
4. Configure the test set deviation meter's audio bandwidth response with a high-pass frequency at $\leq$ 15 Hz and low-pass frequency at $\geq$ 3 kHz.
5. Disable the deviation meter's de-emphasis function.
6. Verify the radio's antenna port is properly terminated (i.e., connected to the test set's T/R port).
7. Press the control head's **MENU** button, then use the •/•• ramp control to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again.
8. Use the •/•• ramp control to scroll through the menu until **P25 HIGH** appears, then select that function by pressing the **MENU** button again. The radio will begin transmitting a standard C4FM high symbol rate pattern.
9. Verify the deviation measured by the test set is between 2545 and 3111 Hz.
10. Press the **MENU** button again to unkey the radio.

11. Use the •/•• ramp control to scroll through the menu until **P25 LOW** appears, then select that function by pressing the **MENU** button again. The radio will begin transmitting a standard C4FM low symbol rate pattern.
12. Verify the deviation measured by the test set is between 849 Hz and 1037 Hz.
13. Press the **MENU** button again to unkey the radio.
14. Record test results in Table 11-13.

Table 11-13: Transmitter P25 (C4FM) Modulation Pattern Test with CH-721 Control Head Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

15. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio before it is returned to normal service; see Section 10.4.4 on page 46 for details.

11.4.8 Receiver Performance Tests

Unless otherwise stated, all receiver performance test procedures presented in this section should be performed in the order presented.

11.4.8.1 Receiver Audio Output Level, Distortion Level, and Speaker Tests

Receiver audio output and distortion levels should always be verified as being good **before** performing a receiver sensitivity test, or other receiver-related tests. This ensures the respective audio circuits in the control head have sufficient output capability and minimal distortion. Follow this procedure:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Connect the modified speaker's unbalanced speaker output (BNC connector or banana plug) to the RF Communication Test Set's audio input measurement port. This connects the radio's/control head's differential speaker output to the test set's audio input measurement port.

The modified speaker contains a 1:1 audio coupling transformer to couple the radio's/control head's balanced speaker output to the modified speaker's unbalanced test port output (BNC connector or banana plug). This output **must** only be connected to a high-impedance load (of any test equipment). Loading this output with a speaker could damage the transformer.

3. Switch the modified speaker's double-pole switch to the speaker position (i.e., speaker on).
4. Set the control head's volume control to a relatively low position.
5. CH-100 Control Head Only: Select the test personality/mission plan via the **PROGRAM** menu.
6. Select the analog conventional test zone/system.

7. Select any analog conventional test channel listed in Table 11-3. Make a mission plan and/or zone change, as necessary.

Do **not** key the radio during this test.

If the test set does not have a (high-power) T/R port, using an external 20- or 30-dB attenuator between the radio's antenna port and the test set's generator/low-power RF output port is recommended. This helps prevent damage to the test set if the radio is accidentally keyed. If an external attenuator is used, all RF signal level measurements must be adjusted accordingly when making RF signal level measurements.

8. Set the RF communications test set on frequency with an RF output level of 47 dBm (1000 µV). This is considered a full-quieting RF signal.
9. Modulate the RF output with a 1 kHz tone with a 60% rated system deviation. See Table 11-8 for values for each bandwidth. This is considered a full-quieting RF signal.
10. Verify the radio is receiving the full-quieting RF signal modulated with the 1 kHz tone. If not, recheck connections and/or radio and test equipment configurations.
11. Switch the modified speaker's double-pole switch to the 4-ohm load position (i.e., speaker off).
12. Adjust the control head's volume control for a speaker output audio level of 7.745 Vrms, as measured by the test set's audio analyzer or AC voltmeter. This is 15 watts into the 4-ohm speaker load. If this minimum level cannot be achieved, re-check speaker connections and/or suspect a problem in the control head's audio amplifier circuits. Correct before continuing.
13. Verify power supply current is between 3.5 and 4.0 amps. If not, suspect a problem in the control head's audio amplifier circuits.
14. Using the test set's audio analyzer, measure the distortion level of the 1 kHz tone from the radio. For the CH-100 control head, distortion should be less than 3%. For the CH-721 control head, distortion should be less than 5%. If the measured distortion exceeds the respective limit, suspect a problem in the control head's audio amplifier circuits. Correct before continuing.
15. Reduce the volume control to a relatively low setting.
16. Switch the modified speaker's double-pole switch to the speaker position (i.e., speaker on).
17. Adjust the volume control to at least a mid-range setting to verify the 1 kHz tone from the speaker is loud and clear.
18. Record test results in Table 11-14.

Table 11-14: Rx Audio Output Level, Distortion Level, and Speaker Tests Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

19. If no additional tests are to be performed, disconnect all test equipment, and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.4.8.2 Receiver 12 dB SINAD Sensitivity Test

Use this test procedure to determine the radio's 12 dB SINAD receiver sensitivity level:

1. Complete the Receiver Audio Output Level, Distortion Level, and Speaker Test procedure presented in Section 11.4.8.1. Leave all equipment connected and configured as described in that procedure.
2. Select the analog conventional 136.000 MHz test channel, as listed in Table 11-3. Make a zone/system change, as necessary.

   Alternately, customer channel(s) can be used for this test, if available, and the utilized test equipment supports the mode of operation. The channel must be programmed for wideband operation.
3. Disable receiver squelch. Refer to the respective **NOTE** that follows, as necessary.

NOTE

Disabling/Enabling Squelch from the CH-100 Control Head:

1. Press the control head's blue **Home** button one or more times until the **MONITOR** soft key appears in the display.
2. Touch the **MONITOR** soft key to toggle squelch on (enabled) and off (disabled). When the monitor function is on (squelch off), the icon appears in the top-center of the display.

NOTE

Disabling/Adjusting Squelch from the CH-721 Control Head:

Before squelch can be adjusted from the CH-721 control head, the **SQUELCH** programmable menu function must be programmed to the conventional menu as described in Section 11.4.4. In this case, adjust squelch as follows:

1. Press the control head's **MENU** button.
2. Press the •/•• ramp control to scroll through the conventional menu until **SQUELCH** appears in the middle line of the display.
3. Press the **MENU** button again.
4. Press the •/•• ramp control **down** until **SQULCH=1** appears in the top line of the display. At this point, squelch is at a minimum setting and essentially disabled.

Squelch can be temporarily disabled by depressing the control head's Clear (**CLR**) button. If depressed for more than approximately two (2) seconds, the CTCSS function programmed for the channel, if any, will toggle on/off, as indicated by the $^{C}_{G}$ icon in the display. Squelch on a channel will be re-enabled when the channel is unselected and then reselected.

4. Set the RF Communication Test Set on frequency with an initial RF output level of approximately -100 dBm (2.25 µV).
5. Verify the radio is receiving the RF signal from the test set. If not, recheck connections and/or radio and test equipment configurations before continuing.
6. Switch the modified speaker's double-pole switch to the 4-ohm load position (i.e., speaker off).
7. Configure the RF Communication Test Set for a 12 dB SINAD level measurement. Modulate the RF output with a 1 kHz tone at 3 kHz deviation (60% rated system deviation for wideband

channel). Adjust the test set's RF output level as necessary to obtain a 12 dB SINAD reading. Volume control adjustments may also be necessary.

8. Verify the 12 dB SINAD level measurement against specifications listed in Section 3.2.3 (page 12). If the 12 dB SINAD level measurement is worse than (i.e., RF signal level greater than) the respective specification, first recheck connections and test set configuration. If the problem cannot be resolved, verify RF channel programming before contacting the L3Harris Technical Assistance Center (TAC) for assistance. The analog conventional test channel must be programmed for wideband operation, as listed in Table 11-3.
9. Select the next test channel listed in Table 11-3, change the test set to the corresponding frequency, and measure the 12 dB SINAD level on the channel. Verify the measured value against the respective specification for the RF band.
10. Repeat until all test channels have been measured.
11. Record test results in Table 11-15.

Table 11-15: Rx 12 dB SINAD Sensitivity Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

12. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.4.8.3 Receiver Analog Squelch Test

Follow this test procedure to check the receiver's noise squelch operation:

1. Select any analog conventional test channel.
2. On this channel, complete a 12 dB SINAD sensitivity test as described in Section 11.4.8.2. Leave the radio, control head, and all test equipment interconnected per that procedure.
3. Turn the test set's RF output level off or set it as low as possible.
4. Set the control head's volume control to a mid-range position.
5. If the radio is not squelched, enable squelch. Refer to the respective **NOTE** in Section 11.4.8.2 as necessary.
6. Verify the radio is squelched (i.e., receiver audio muted).
7. Slowly increase the generator's RF output level to determine the SINAD level at squelch opening (i.e., the SINAD level when receiver audio unmutes). Be sure to observe the measured value at the SINAD meter, not the test set generator's RF output level. Radio volume control adjustments may also be necessary. The SINAD level should be approximately between 6 dB and 10 dB SINAD. This measurement can be somewhat erratic and often interpreted by the tester.
8. Increase the generator's RF output level at least another 6 dB (i.e., double the RF output voltage).

9. While observing the test set's SINAD meter, slowly decrease the RF output level to determine the SINAD level at squelch closing (i.e., the SINAD level when receiver audio mutes). Again, be sure to observe the measured value at the SINAD meter, not the test set generator's RF output level. The SINAD level will be unstable, but around 3 dB SINAD when the receiver squelches. This indicates less of an RF signal is required to squelch the receiver than to unsquelch it.
10. Verify the difference between the measured squelch opening and squelch closing SINAD levels is between 1 and 3 dB. This is the squelch hysteresis. It may be necessary to vary the generator's RF output level up and down several times around these squelch threshold points to verify measurements.
11. Record test results in Table 11-16.

Table 11-16: Rx Noise Squelch Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

12. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.4.8.4 Receiver CTCSS/CDCSS Decode Test

Follow this test procedure to verify Continuous Tone-Coded Squelch System (Channel Guard) and Continuous Digital-Coded Squelch System (Digital Channel Guard) decode operations:

1. Complete the Receiver Analog Squelch Test presented in Section 11.4.8.3.
2. At the control head, select an analog conventional test channel that has CTCSS or CDCSS pre-programmed.
3. CH-100 Control Head Only: Access the **CHANNEL INFO** screen and scroll down to observe/verify the **RX CG** mode (CTCSS or CDCSS) and the **RX TONE** (for CTCSS) or **RX CODE** (for CDCSS).

NOTE

For the CH-100 control head, in lieu of a test channel pre-programmed with a CTCSS/CDCSS tone/code, the edit channel function can be used to edit an existing test conventional channel by enabling CTCSS/CDCSS and setting the tone/code as required. On the **CHANNEL INFO** screen, this is accomplished via the **EDIT CHAN** soft-button and the Maintenance Password set for the current personality/mission plan.

4. CH-721 Control Head Only: Press the control head's **MENU** button then use the •/•• ramp control to scroll through the conventional menu until **CG SEL** appears in the middle line of the display and press the **MENU** button. Next, observe/verify the current CTCSS tone. If necessary, use the •/•• ramp control to scroll through the CTCSS tone list for a different tone, and press the **MENU** button again.
5. Set the RF communications test set as follows:
   a. RF signal generator frequency to the test frequency.
   b. RF signal generator RF output level at the previously measured 12 dB SINAD sensitivity level.

c. 1 kHz test tone at 60% system deviation (see Table 11-8 as required).

d. CTCSS/CDCSS tone/code to match the tone/code of the selected test channel.

e. CTCSS/CDCSS tone/code deviation to 0.5 kHz for a wideband channel, 0.35 kHz for narrowband channel, or 0.4 kHz for a NPSPAC channel.

6. Verify the 1 kHz test tone is sounding from the radio's speaker.
7. Change the test set's function generator away from the tested CTCSS/CDCSS tone/code. Receiver audio should mute.
8. Repeat this test for other CTCSS tones, other CDCSS codes, and other channel bandwidths. Specific CTCSS tones and CDCSS codes are listed in the RPM programming software's help screens.
9. Record test results in Table 11-17.

Table 11-17: Receiver CTCSS/CDCSS Decode Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

10. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio before it is returned to normal service; see Section 10.4.4 on page 46 for details.

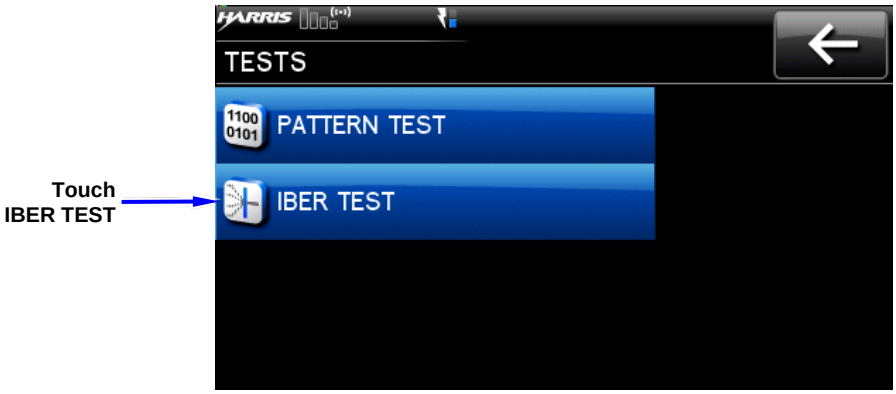
11.4.8.5 Receiver P25 Sensitivity (C4FM BER) Test with CH-100 Control Head

Use this test procedure to check P25 receiver sensitivity of the XG-100M radio with a CH-100 control head:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select the P25 conventional test zone/system.
3. Select a test channel within that zone/system. They channel must be programmed for C4FM modulation.
4. Set the RF Communication Test Set on frequency at an RF output level of -119 dBm (0.25 µV).
5. Modulate the test set with a standard 1011 P25 (C4FM) test pattern/tone.

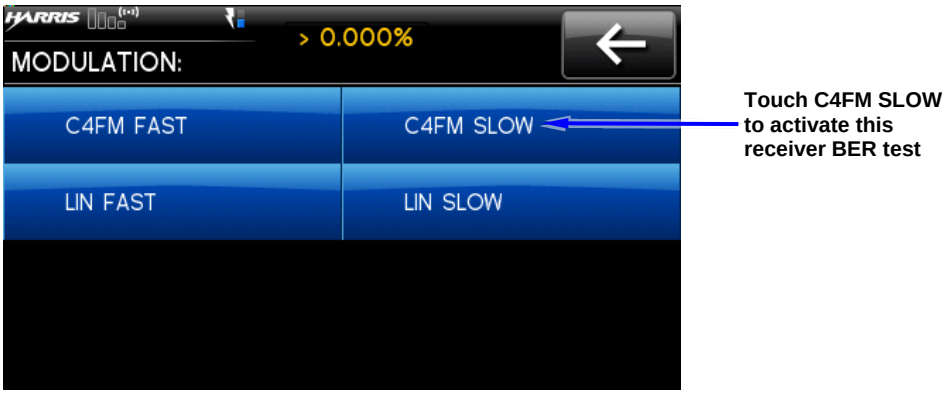
6. In the radio's **UTILITIES** menu, touch **TESTS**. If this selection is not available (i.e., if it is dimmed-out), the currently selected channel is not programmed for P25 (C4FM) operations.

7. When prompted, enter the password, and then touch **OK**. The password is the **Maintenance Password** defined in the personality/mission plan.
8. Touch **IBER TEST**.



The **MODULATION** screen displays, as shown in the next step.

9. Touch **C4FM SLOW**.



A white arrow appears next to **C4FM SLOW** to indicate this receiver BER test is currently active.

10. Verify a 1 kHz tone is sounding from the radio's speaker per the received 1011 test pattern/tone. If not, check volume control setting, RF cable connections, test set RF output frequency, test set modulation pattern, etc.

11. Verify the measured receiver BER is less than 5.1% but **not** "**> 0.000%**." If the latter is displayed, the radio is not receiving any C4FM signal and/or it has not locked onto the received signal; in this case, check RF cable connections, test set RF output frequency, test set modulation pattern, etc.

12. To end this test, touch ← to return to the main menu.
13. Record test results in Table 11-18.

Table 11-18: Rx P25 Sensitivity (BER) with CH-100 Control Head Test Results

Radio Part Number	Radio Serial Number	Pass/Fail	Test Date	Technician's Initials
12099-1000-01				

14. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.4.8.6 Receiver P25 Sensitivity (C4FM BER) Test with CH-721 Control Head

Use this test procedure to check P25 receiver sensitivity of the XG-100M radio with a CH-721 control head:

1. Setup the radio, control head, and test equipment per the Bench Setup procedure in Section 11.4.5.
2. Select the P25 conventional test zone/system.
3. Select a test channel within that test zone/system. This channel must be programmed for C4FM operations.
4. Set the RF Communication Test Set on frequency at an RF output level of -119 dBm (0.25 µV).
5. Modulate the test set with a standard 1011 P25 (C5FM) test pattern/tone.
6. Press the control head's **MENU** button, then use the •/•• ramp control to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again.
7. Use the •/•• ramp control to scroll through the menu until **IBERC4FM** appears and select that function by pressing the **MENU** button again. The radio displays the internally calculated Bit Error Rate (BER) of the received test pattern/tone.

NOTE

If the IBERC4FM function was the last selected function in the Revision menu, **IBERC4FM** is not displayed when scrolling through the menu. In this case, a greater than symbol (>) at the left in the middle line of the display indicates it is the currently selected function, followed by the currently measured Rx BER percentage.

8. Press the **MENU** button again to toggle the display from fast BER to slow (averaging) BER.
9. Verify the displayed BER is not 0%, but less than 5%. If 0.000% is displayed, the radio is not receiving an on-channel C4FM-modulated RF signal from the test set.
10. Repeat BER measurements on the other test channels.
11. Record test results in Table 11-19.

Table 11-19: Rx P25 Sensitivity (BER) with CH-721 Control Head Test Results

Radio Part Number:	Radio Serial Number:	PASS/FAIL	Test Date:	Technician's Initials:
12099-1000-01				

12. If no additional tests are to be performed, disconnect all test equipment and remove the test personality/mission plan from the radio. The test personality/mission plan **must** be removed from the radio and the original restored before the radio is returned to normal service.

11.5 DISPLAYED ERROR MESSAGES (WITH CH-100 CONTROL HEAD)

Table 11-20 lists error messages that may be displayed, the reason, and possible resolution.

Table 11-20: Displayed Error Messages, Reasons, and Resolutions

SCREEN/ MENU	DISPLAYED ERROR MESSAGE	REASON	RESOLUTION
Top-Level Screen	**DELETE NOT ALLOWED**	Nuisance delete not allowed on current channel.	Requires new personality configuration (either Limited/Programmable scan lists or Keypad P1/P2 channels).
	EMERGENCY ACTIVE SCAN DISABLED	Cannot scan in emergency mode.	Exit emergency mode to start scanning.
	OTAR REKEY FAILED	Self-explanatory.	Attempt OTAR operation again.
	OTAR ZEROIZE FAILED	Self-explanatory.	Attempt OTAR operation again.
	NO OTAR KEK LOADED	Self-explanatory.	Load valid UKEK, then retry OTAR operation. See Section 10.6 which begins on page 48 for additional information.
	INVALID OTAR KEYSETS	OTAR configuration failed because keysets were improperly configured.	Zeroize keys and reload UKEK, then retry OTAR operation. See Section 10.6 which begins on page 48.
	INVALID KEYSTORE ZEROIZE NEEDED	Corrupt key database.	Zeroize the database. See Section 10.6.3 which begins on page 54.
	SYNTH OUT OF LOCK	DSP synthesizer out of lock.	Channel will reselect automatically to attempt to obtain synthesizer lock.
	SYNTH OUT OF LOCK POWER CYCLE RADIO	DSP synthesizer out of lock--unable to restore by reselecting channel.	Unable to obtain synthesizer lock. Power cycle. Contact L3Harris if problem persists.

Table 11-20: Displayed Error Messages, Reasons, and Resolutions

SCREEN/ MENU	DISPLAYED ERROR MESSAGE	REASON	RESOLUTION
Bluetooth Pairing Screen	**PAIRING FAILED**	Bluetooth pairing failed.	Ensure the device is discoverable and attempt to re-pair the device.
	PIN CODE MUST HAVE AT LEAST 4 DIGITS	Entered PIN was too short.	Enter at least four (4) digits.
Channel Edit Screen	**EDIT FAILED**	Unable to modify P25 Channel.	Power cycle and try again. Contact L3Harris if problem persists.
	INVALID RX FREQUENCY	Entered Rx frequency is invalid.	Ensure frequency follows band spacing rules.
	INVALID TX FREQUENCY	Entered Tx frequency is invalid.	Ensure frequency follows band spacing rules.
	INVALID CODE	Code entered is not a valid CDCSS code.	Ensure entered CDCSS code is valid.
Mission Plan List Screen	**EMERGENCY ACTIVE FILL DISABLED**	Cannot activate mission plans in emergency mode.	Disable emergency mode to activate a new mission plan.
Install Operations	**INSTALL NOT ALLOWED**	Error during install process.	Transfer file again and reattempt install. Contact L3Harris if problem persists.
	EXTRACTION FAILED	Extraction of compressed file failed.	Transfer file again and reattempt install. Contact L3Harris if problem persists.
	REMOVE FAILED	Removal of existing SW failed.	Attempt install again and contact L3Harris if problem persists.
Mission Plan In Progress Screen	**PLAN FAILED**	Mission plan activation failed.	Use RPM to ensure plan validity. Contact L3Harris if failures persist.
Security Menu	**ZEROIZE FAILED**	DSP could not zeroize.	DSP problem—power cycle and contact L3Harris if problem persists.
	NO KEYS TO ZEROIZE	Key database empty.	Nothing to zeroize.
Utilities Menu	**INCORRECT PASSWORD**	Maintenance password invalid.	Enter valid maintenance password.
Channel Info Screen	**INCORRECT PASSWORD**	Channel edit password invalid.	Enter valid channel edit password.

11.6 RADIO CONNECTOR PIN-OUTS

11.6.1 9-Pin I/O Connector on Rear Panel (TIA/EIA/RS-232C Serial Port)

The 9-pin D-subminiature (DB-9) connector on the rear panel of the radio is a multi-purpose TIA/EIA/RS-232C serial port. Its pin-out is included in Table 11-21.

This serial port is used during radio programming operations. In this manual, see Section 10 for details. Radio programming information is also included in RPM's online help.

This serial port can also be used for connection to optional serially-interfaced equipment such as a computer/laptop running Mobile Data Terminal (MDT) software. For connections details, refer to the radio's *Installation Manual*, publication number 14221-1200-4440.

In addition, this port is used for diagnostic testing performed at the factory.

Table 11-21: 9-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	DESCRIPTION
1	DCD_A	RS-232C Data-Carrier-Detect output
2	TD_A	RS-232C Transmit-Data output
3	RD_A	RS-232C Receive-Data input
4	DSR_A	RS-232C Data-Set-Ready input
5	GND	RS-232C signal ground/reference
6	DTR_A	RS-232C Data-Terminal Ready output
7	CTS_A	RS-232C Clear-To-Send input
8	RTS_A	RS-232C Ready-To-Send output
9	RI_A	RS-232C Ring Indicator output

11.6.2 44-Pin I/O Connector on Rear Panel (for Optional/Accessory Connections)

The 44-pin D-subminiature (DB-44) connector of the rear panel of the radio is a connection point for optional inputs and outputs. The pin-out for this connector and the respective connectors of Option Cable 14002-0174-01 (formerly CA-012349-001) are included in the following table.

NOTE

Option Cable assembly and wiring diagrams are shown in Section 12.1 on page 93.

Table 11-22: Radio's 44-Pin Connector Pin-Out and Option Cable 14002-0174-01 Interconnections

RADIO'S 44-PIN CONNECTOR (P1 PIN)	SIGNAL NAME	CABLE 14002-0174-01 (formerly CA-012349-001)	DESCRIPTION
19	SPKR1	P2 pin 1	Speaker Audio Outputs 1 and 2. In a front-mount radio installation, this differential output drives the radio installation's external speaker. This output is not functional in a remote-mount radio installation; in this case, the speaker output from the control head drives the external speaker.
20	SPKR1		
21	SPKR2	P2 pin 2	
22	SPKR2		
10	OUT2	P3 pin 1	Digital Output 2 (open-collector, 100 mA / 17 V maximum). An external pull-up resistor is needed if required by the external device's input during the high/off state. Use P3 pin 2 or 4 for ground. Configure via the "External Output Control Line 2" in Radio Personality Manager's (RPM's) External I/O dialog box. For example, an external logging recorder's record enable/disable input can be controlled by setting "External Output Control Line 2" to "Extern. Tx Indicator."
7	GND	P3 pins 2 & 4	Chassis Ground (fused on radio's PK Board).
26	HKSW	P3 pin 3	Digital Input for Hookswitch (default) or for radio PTT. Active = Ground. Inactive = Open.
25	INP2	P3 pin 5	Digital Input 2. Active = Ground. Inactive = Open. Use P3 pin 2 or 4 for ground. Configure via the "Auxiliary Input 2" in Radio Personality Manager's (RPM's) External I/O dialog Box.
28	SWA+	P3 pin 6	Switched A+ (DC Power) Output.
8	GND	P4 pin 1	Chassis ground (fused on PK Board).
30	DGPS_DATA	P4 pin 4	GPS Receiver Module DGPS Correction Data Serial Data Input (NMEA formatted).
4	EXTRX	P4 pin 5	External Rx Audio Input (from external/2nd receiver; summed).
9	RESERVED	P4 pin 7	Not used.

Table 11-22: Radio's 44-Pin Connector Pin-Out and Option Cable 14002-0174-01 Interconnections

RADIO'S 44-PIN CONNECTOR (P1 PIN)	SIGNAL NAME	CABLE 14002-0174-01 (formerly CA-012349-001)	DESCRIPTION
3	SDATA	P4 pin 8	In a front-mount radio installation, this pin for the siren/PA interface is the siren serial data output (open-collector/open-drain) from the radio's mounted (local) control head. It serially transfers siren and light control data from the control head to a connected third-party siren and light system (e.g., Federal Signal SS2000 SmartSiren). Data rate = 1200 bps. Connects to SS2000's DB-9 pin 3. For a remote-mount radio installation, see footnote 9.
5	FDISC	P4 pin 9	Buffered Filtered Discriminator Audio Output (not normally used). A fixed-level audio output with DC bias. Approximately 200 mV rms into a 600-ohm load at rated deviation. Does not contain signaling (e.g., CTCSS). Mutes when speaker mutes. Use a 33 µF / 50 V (or greater) coupling capacitor to connect to a 600-ohm load. Use P4 pin 12 for ground.
13	ALO	P4 pin 10	In a front-mount radio installation, this 600-ohm AC-coupled differential audio output from the mounted (local) control head is typically not used. In a remote-mount radio installation, these two pins of the radio's DB-44 connector are not functional.
12	MICHI	P4 pin 11	
1	EXTALO	P4 pin 12	In a front-mount radio installation, VOLHI (a single-ended AC-coupled audio signal) and EXTALO (signal ground) provide public address (PA) mic audio from the mounted (local) control head to a siren and light system, such as the Federal Signal SS2000 SmartSiren. Pin 13 connects to SS2000's DB-9 pin 5. Pin 12 connects to SS2000's DB-9 pin 6. For a remote-mount radio installation, these two pins can provide an unmuted volume-level-controlled single-ended audio signal to external devices. P1 pin 1 (EXTALO) is over-current protected on radio's PK Board by a 1-amp fuse.
14	VOLHI	P4 pin 13	
15	CTLON	P4 pin 14	Control-On Digital Input. Logically ORed on radio's PK Board with a CAN receiver activity logic signal, so either input can turn on the radio. Not normally used.
16	XTONEENC	P4 pin 15	External Tone Encode Audio Input (default) or Auxiliary Mic Audio Input.
17	XTONEDEC	P4 pin 16	External Tone Decode Audio Output.

[9] In a remote-mount XG-100M radio installation, this pin on the radio's DB-44 connector is typically not used. For the CH-721 control head, use the respective pin on the CH-721 Option Cable's female DB-25 pin connector; refer to the radio's *Installation Manual* for additional information.

Table 11-22: Radio's 44-Pin Connector Pin-Out and Option Cable 14002-0174-01 Interconnections

RADIO'S 44-PIN CONNECTOR (P1 PIN)	SIGNAL NAME	CABLE 14002-0174-01 (formerly CA-012349-001)	DESCRIPTION
6	EXTALO	P4 pin 17	Reference/Ground for external audio. Over-current-protected on radio's PK Board by a 1-amp fuse.
24	HORNRING	P4 pin 18	In a front-mount radio installation, this pin for the siren/PA interface is the horn/ring logic input to the radio's mounted (local) control head. When a connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) has its horn/ring function active, this input is used to signal the control head/radio as such. Connects to SS2000's DB-9 pin 8. For a remote-mount radio installation, see footnote 9.
23	SONOFF	P4 pin 19	In a front-mount radio installation, this pin for the siren/PA interface is the siren on/off logic output (open-collector) from the radio's mounted (local) control head. It is the signal that powers the connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) on and off. Connects to SS2000's DB-9 pin 4. For a remote-mount radio installation, see footnote 9.
18	INP1	P4 pin 21	Digital Input 1. Active = Ground. Inactive = Open. Use P4 pin 1 for ground. Configure via the "Auxiliary Input 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
2	OUT1	P4 pin 22	Digital Output 1 (open-collector, 100 mA / 17 V maximum). An external pull-up resistor is needed if required by the external device's input during the high/off state. Use P4 pin 1 for ground. Configure via the "External Output Control Line 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
29	TXENB+	P4 pin 23	Transmit Enable B+ Output (open collector). Active/Radio Transmitting = Ground. Inactive/Not Transmitting = Open. (not normally used).
27	EXTMIC	P4 pin 24	External/Auxiliary Mic Audio Input. Fixed-level audio input (i.e., input gain is not adjustable). Approximately 120 mV rms gives full-rated deviation. Use P4 pin 17 for ground.
28	SWA+	P4 pin 25	Switched A+ DC Power Output (not normally used).
32	GPS_NMEA_RX	P5 pin 2	NMEA-Formatted GPS Receiver Position Data Serial Data Output.

Table 11-22: Radio's 44-Pin Connector Pin-Out and Option Cable 14002-0174-01 Interconnections

RADIO'S 44-PIN CONNECTOR (P1 PIN)	SIGNAL NAME	CABLE 14002-0174-01 (formerly CA-012349-001)	DESCRIPTION
31	GPS_NMEA_TX	P5 pin 3	NMEA-Formatted GPS Receiver Module Initialization Data Serial Data Input.
7	GND	P5 pin 5	Ground for GPS Serial Data Signals (fused on radio's PK Board).
11	IGNITION	Yellow Wire	Unused/Spare ignition sense input.
33 - 44	—	(no connections)	These twelve pins of P1 are not used/not connected when the Option Cable is connected.

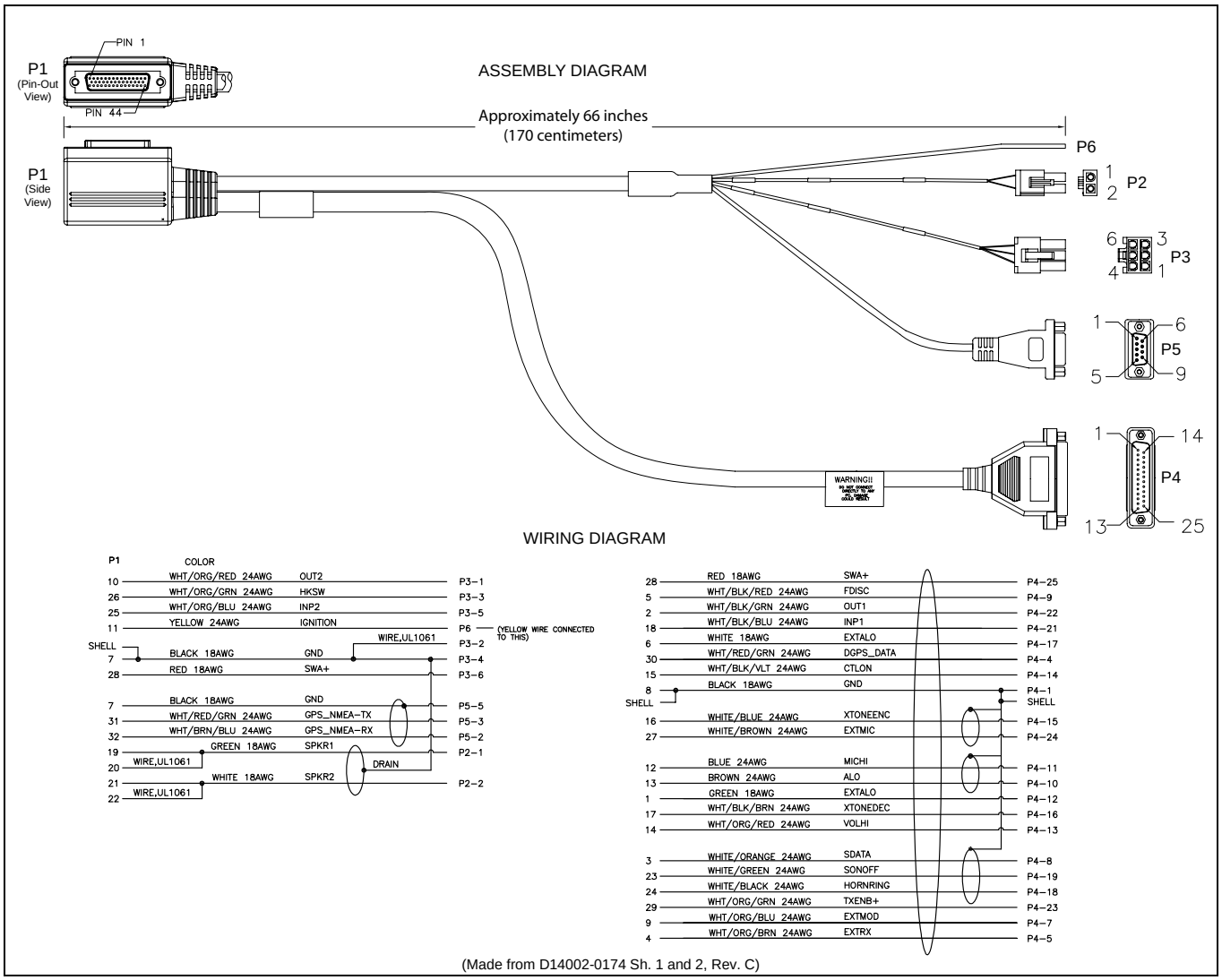
12. OPTIONAL CABLES

12.1 OPTION CABLE 14002-0174-01 (FORMERLY CA-012349-001)

Option Cable 14002-0174-01 connects to the 44-pin I/O connector on the rear of the radio. It breaks out into several smaller standardized connectors, allowing straightforward access to external I/O interfaces provided by the radio. The cable also shortens radio removal and re-installation time when required. The cable is shown in Figure 12-1 below. The cable's 44-pin D-subminiature connector that mates with the connector on the rear of the radio is identified P1. This cable is equivalent to and it replaces cable CA-012349-001.

CAUTION

Observe caution before connecting any external device to the radio via its 44-pin I/O connector. If an external device has its own DC power source/cable (i.e., if it is powered separately from the radio), both the radio **and** the external device must be properly grounded to the vehicle **before** connecting the two units together and before making a positive (+) DC power connection to either unit. Otherwise, equipment damage may occur.



(Made from D14002-0174 Sh. 1 and 2, Rev. C)

Figure 12-1: Option Cable 14002-0174-01

P2, the cable's 2-pin connector, provides connections for an external speaker in a front-mount radio installation, or in a remote-mount radio installation with an HHC-731 hand-held controller. For connection information, refer to the radio's *Installation Manual*. P2 is not used in a remote-mount radio installation, since the audio amplifier in the control head drives the external speaker (speaker connection is made at the rear of the control head).

P3, the cable's 6-pin connector, is a connector for basic accessories (e.g., hookswitch, external relay with back-EMF diode, etc.).

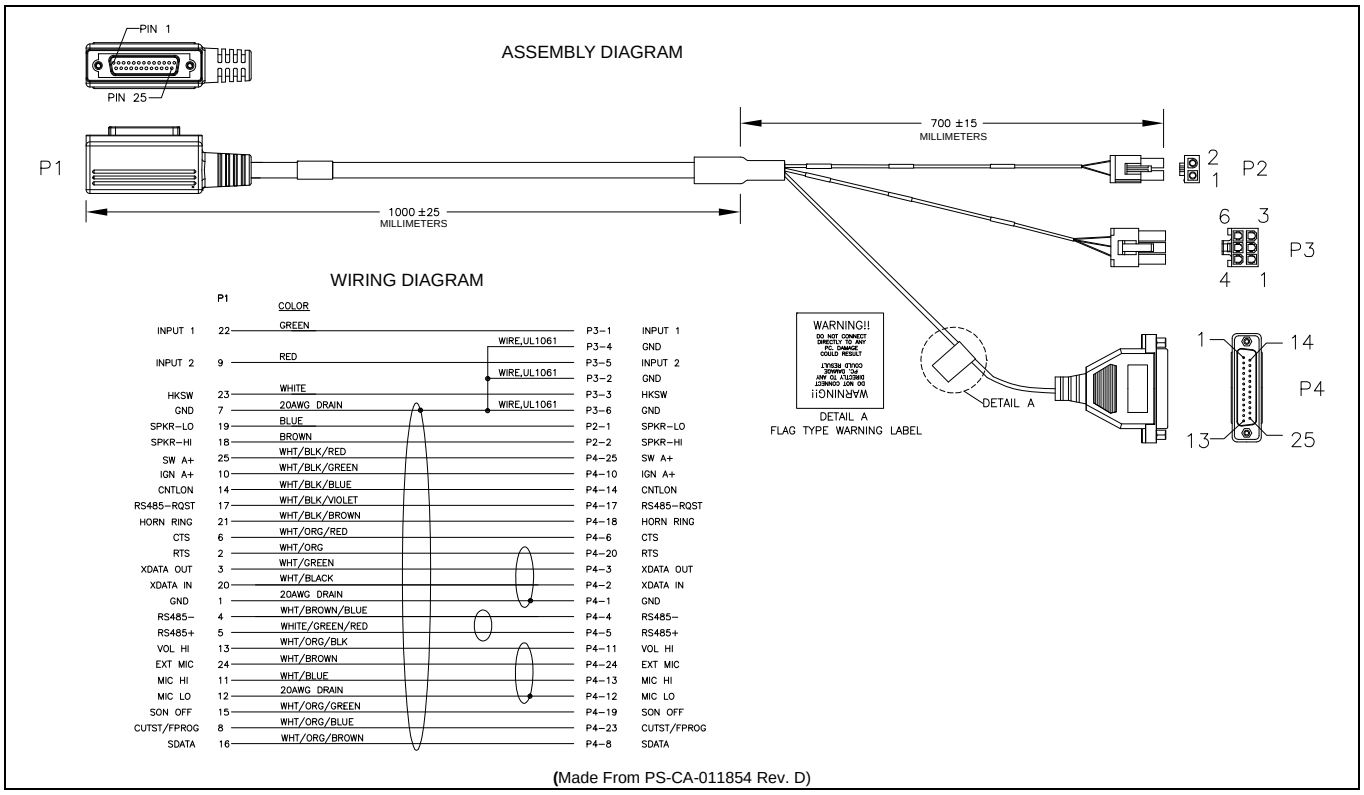
P4, the cable's D-subminiature 25-pin connector, provides audio and data connections for optional equipment such as an external siren and light system (e.g., Federal Signal SS2000 SmartSiren®), external relay with back-EMF diode, etc.

P5, the cable's D-subminiature 9-pin connector, provides NMEA-formatted GPS serial data connections for the external computer processing the NMEA-formatted GPS data received by the radio's internal GPS receiver. See the radio's *Installation Manual* for additional information.

12.2 CONTROL HEAD OPTION CABLE CA-011854-001

Control Head Option Cable CA-011854-001 can be used to connect optional equipment to the 25-pin D-subminiature (DB-25) connector on the rear of the CH-100 or the CH-721 control heads. This cable expands the connections available at the control head's 25-pin connector into three (3) separate connectors. The cable's assembly and wiring diagrams are shown in Figure 12-2 below.

This cable can also be used together with Accessory Cable 19B802554P24 (page 96) to provide siren/light control system connections for an HHC-731 hand-held controller. The cable connection procedure is included in the radio's *Installation Manual*.



(Made From PS-CA-011854 Rev. D)

Figure 12-2: Control Head Option Cable CA-011854-001

NOTE

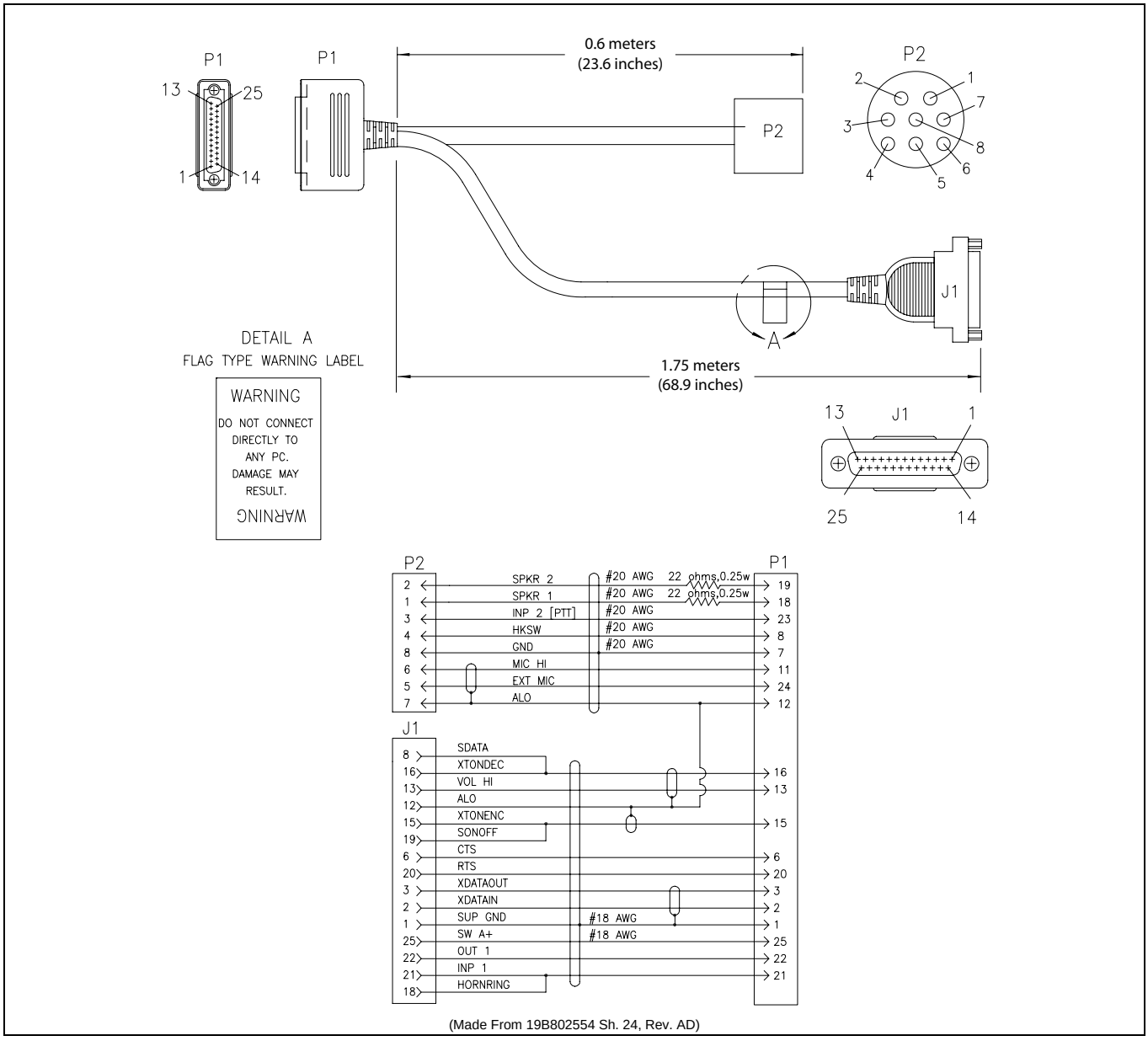
Release R2 (and later) and the CH-100 Control Head - A remote-mount radio with Release R2 (and later) radio firmware supports an external siren and light system via the 25-pin connector on the rear of the control head and cable CA-011854-001. Also, external radio keying (external PTT) is supported via the control head's auxiliary logic inputs (INPUT 1 and INPUT 2 = P1 pins 22 and 9/P3 pins 1 and 5 respectively). These two logic inputs are not configurable for other functions. This release also provides line-level audio output for a public-address function.

12.3 ACCESSORY CABLE 19B802554P24

When a remote-mount radio installation employs the HHC-731 hand-held controller, Accessory Cable 19B802554P24 is required to make connections to an external siren and light control system. This cable's male DB-25 connector, identified P1, mates to the female DB-25 connector of the HHC-731 Interface Cable. The cable's assembly diagram is illustrated in Figure 12-3.

Connector J1 mates with a cable provided with the siren and light control system. Refer to the radio's *Installation Manual* for cable connection instructions.

Connector P2 is not used in this application of the cable.

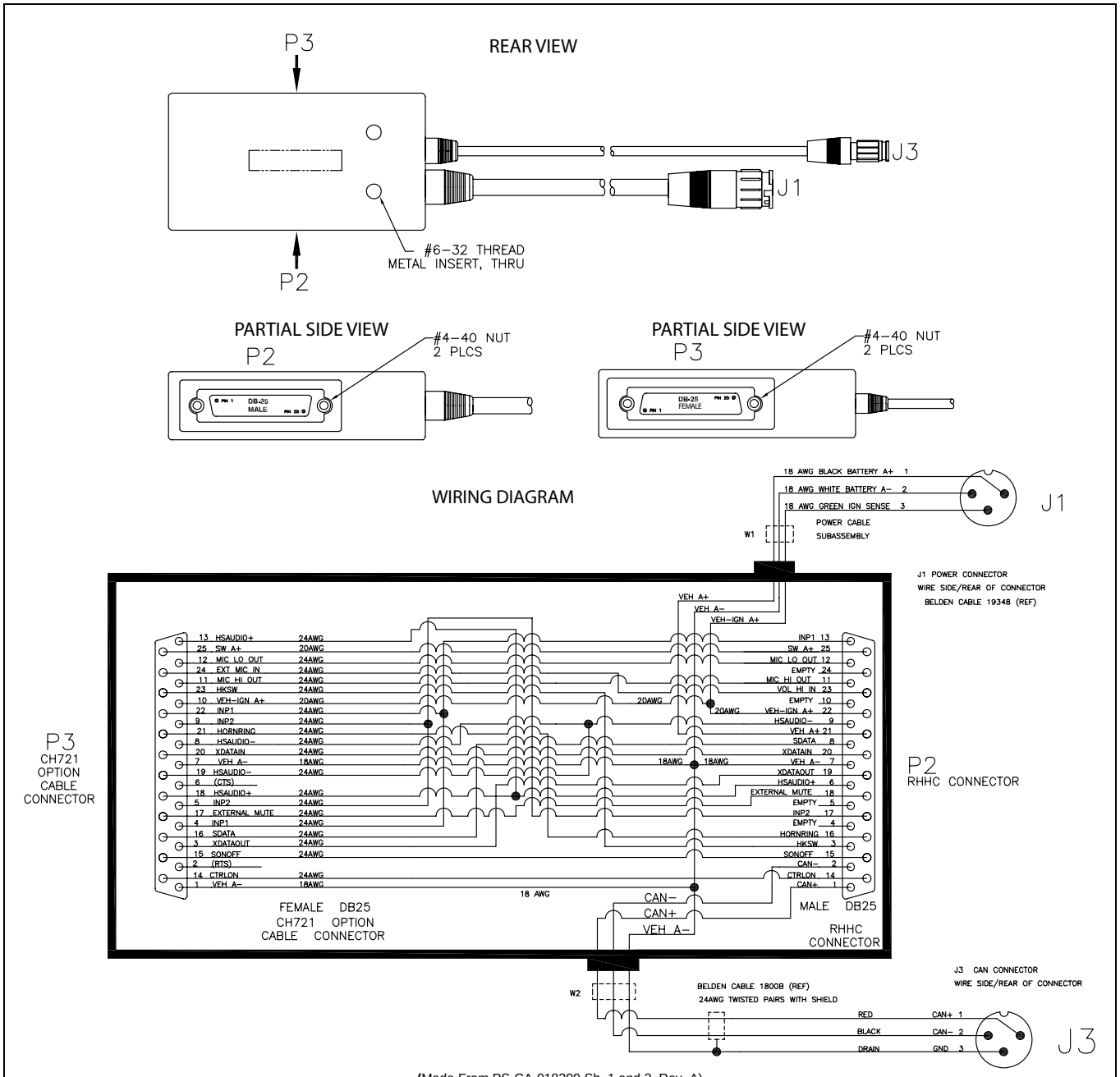


(Made From 19B802554 Sh. 24, Rev. AD)

Figure 12-3: Accessory Cable 19B802554P24

12.4 HHC-731 INTERFACE CABLE CA-018399-001

HHC-731 Interface Cable CA-018399-001 interconnects a DC power cable and the CAN cable from the radio to the HHC-731 hand-held controller. It also has a 25-pin connector that can be used to connect optional equipment to the HHC-731. The cable's assembly and wiring diagrams are shown in Figure 12-4 below. Connector J1 mates with the DC power cable from the main and switched fused power sources. Connector J3 mates with the CAN cable from the radio. Connector P2 (male DB-25) mates to the coiled cord of the CH-721 hand-held controller. Connector P3 (female DB-25) is the connector for optional connections, such an external siren and light system (e.g., Federal Signal SS2000 SmartSiren®). Refer to the radio's *Installation Manual* for cable installation instructions.



(Made From PS-CA-018399 Sh. 1 and 3, Rev. A)

Figure 12-4: HHC-731 Interface Cable CA-018399-001

12.5 SERIAL DATA CABLE CA-013671-020

Serial Data Cable CA-013671-020 (20 feet long) can be used make data connections to the radio to support data communications equipment such as a GPS NMEA-format device. It can also be used to program and configure the radio via a Personal Computer (PC). The cable's assembly and wiring diagrams are shown in Figure 12-5.

The cable's male DB-9 connector (J1) mates to the female DB-9 serial port connector on the rear of the radio. Alternately, if the cable is being used to carry GPS NMEA-formatted serial data from the radio, this male DB-9 connector mates to connector P5 of Option Cable 14002-0174-01.

The cable's female DB-9 connector (J2) mates to a PC's male DB-9 serial port connector. If the utilized PC is not equipped with a DB-9 serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. As of the publication of this manual, CN24741-0001 is available via the L3Harris Customer Care center; refer to Section 6 on page 25 for contact information.

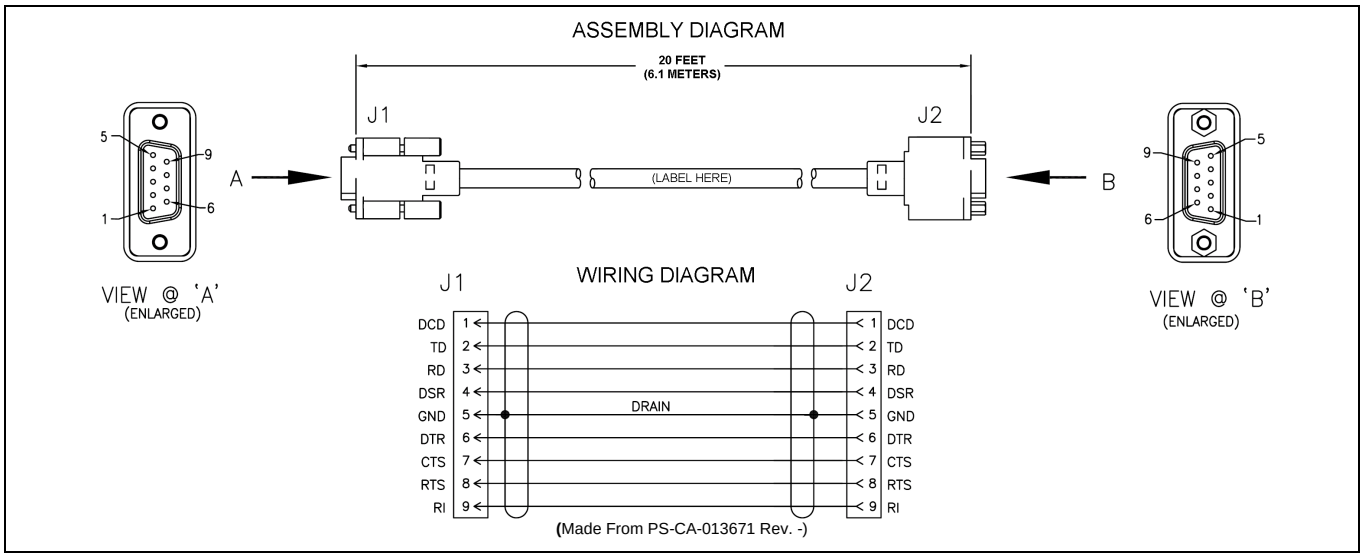


Figure 12-5: Serial Data Cable CA-013671-020

12.6 CH-721 SERIAL PROGRAMMING CABLE CA-104861

Serial Programming Cable CA-104861 (5 feet long) can be used to program and configure the CH-721 control head via a Personal Computer. It has a female DB-9 connector on one end for connection to the PC's serial port connector and a male DB-9 connector on the other end for connection to the serial port connector on the rear of the control head. Refer to the respective *Software Release Notes* for programming and configuration information.

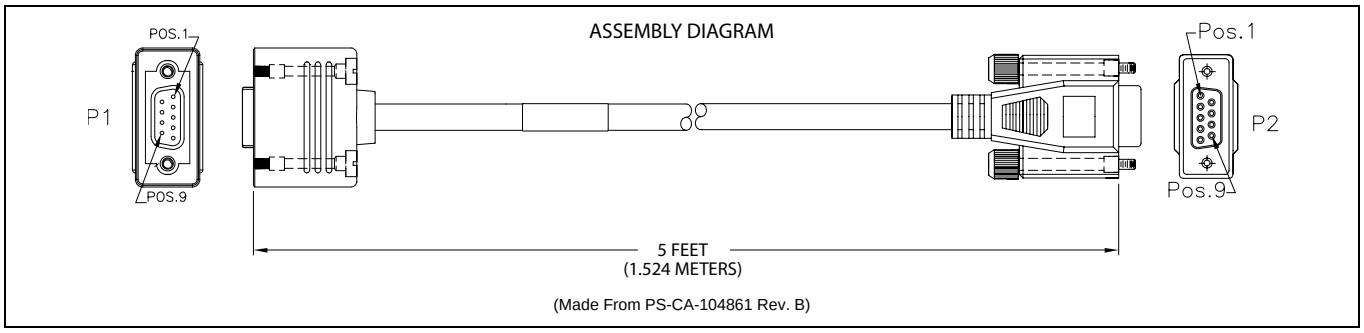


Figure 12-6: CH-721 Serial Programming Cable CA-104861

12.7 CH-721 MIC CONNECTOR PROGRAMMING CABLE CA-103541-001

CH-721 Mic Connector Programming Cable CA-103541-001 (4 feet long) can be used to program and configure the CH-721 control head via its front-panel microphone connector. It has a female DB-9 connector on one end for connection to a PC's serial port connector and a 17-pin Conxall-style connector on the other end for connection to the control head's mic connector. Refer to the respective *Software Release Notes* for programming and configuration information.

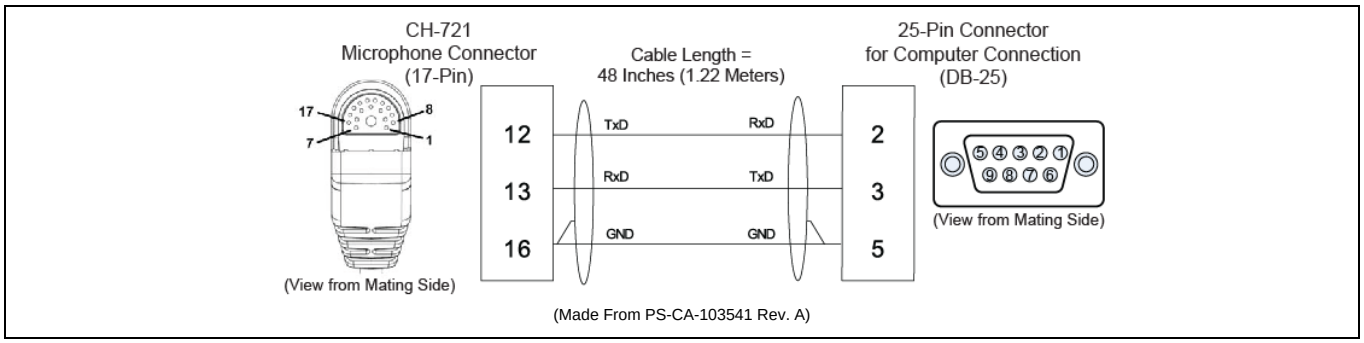


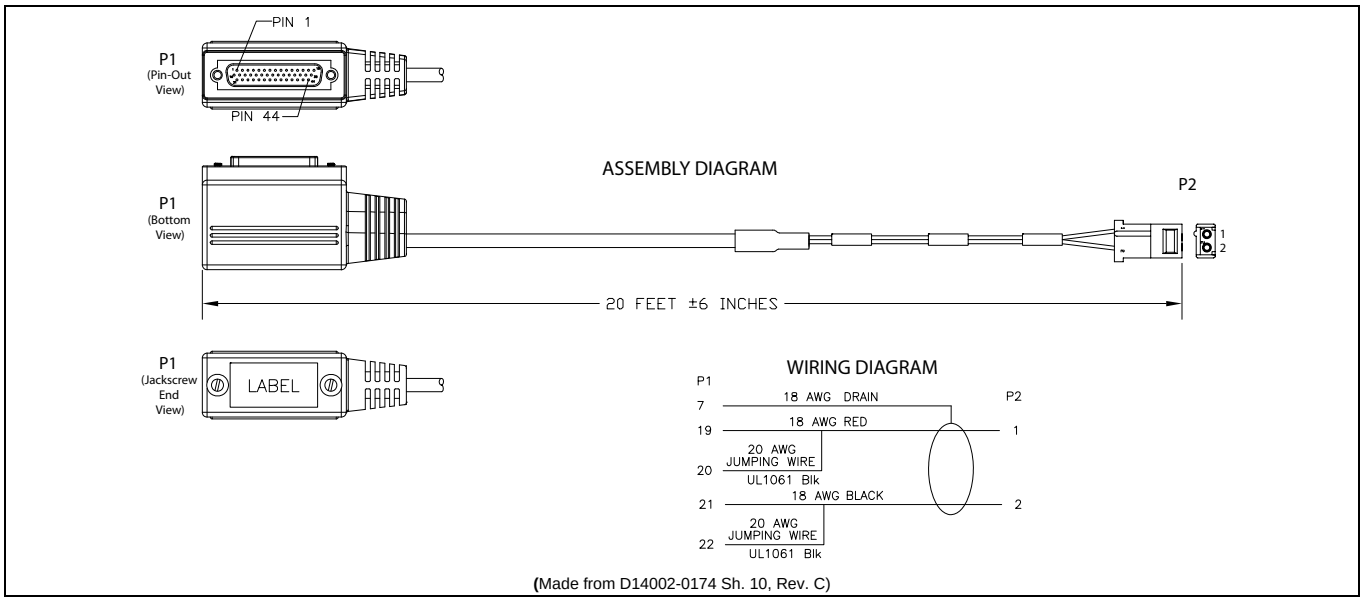
Figure 12-7: CH-721 Serial Programming Cable CA-103541-001

12.8 SPEAKER-ONLY OPTION CABLE 14002-0174-07 (FORMERLY CA-012349-007)

Speaker-Only Option Cable 14002-0174-07 is typically only used to make speaker connections to the radio when the HHC-731 hand-held controller is employed. Optional connections **cannot** be made to the 44-pin (DB-44) connector on the rear of the radio when this cable is used. This 20-foot cable connects the radio's high-power speaker audio output to the 2-wire leads of the speaker. Refer to the radio's *Installation Manual* for cable installation instructions.

This cable can also be used for the same purpose in front-mount radio installation if no optional connections must be made to the radio's 44-pin (DB-44) connector. Connector P1 mates to the 44-pin connector on the rear of the radio. Connector P2 mates to the speaker's 2-pin connector.

Speaker-Only Option Cable 14002-0174-07 is equivalent to and it replaces cable CA-012349-007.



(Made from D14002-0174 Sh. 10, Rev. C)

Figure 12-8: Speaker-Only Option Cable 14002-0174-07

13. TROUBLESHOOTING

13.1 GENERAL

This section provides a guide to quickly isolate a problem to either a hardware or software fault. Software errors and problems can usually be corrected in the field. Hardware failures are harder to isolate and are sometimes very difficult to repair without specialized tools. Hardware repair in the field for this radio is limited; for best results, repairs should be completed through the Repair and Return operation within L3Harris per the Repair and Return policy. Repair and Return has provisions in place for Circuit Board and Module replacement, as required. This section includes a General Troubleshooting Table (Table 13-1) which provides a list of symptoms and possible causes. Table 13-2 provides a list of possible radio error codes. Supporting drawings are available in Section 14.

Table 13-1: General Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Radio will not turn on.	No power.	Test the connection to the vehicle power supply.
Radio will not turn off.	If in multiple control head configuration, one of the attached control heads is still powered up.	Power off all control heads.
At power-up an error message is displayed	Radio may be programmed incorrectly.	See Table 13-2 for type of error and for a probable solution. Attempt to reprogram the personality, Flash and DSP using RPM.
No audio.	Speaker volume is muted.	Increase the volume level.
Poor audio.	Transmitting or receiving in a poor coverage area or subject to interference.	Check network connectivity and move to a better coverage area if possible. Report the area without coverage to an authorized network technician.
Radio will not transmit.	Radio may be out of coverage area or may be overheated.	Return to coverage area if possible. If overheated, let radio cool before retrying transmission. Report this failure to an authorized technician.
Control head randomly changes display.	In multiple control head configurations, another user may be operating the radio from another control head.	None
Encrypted calls cannot be made.	Not authorized to use.	Contact system administrator to request encryption privileges.
Transmitter inoperative or low power	Radio may be programmed incorrectly or antenna may be damaged.	Defective antenna or antenna cabling - replace antenna or antenna cable. Programmed incorrectly - check personality.

13.2 STATUS AND ERROR CODES DISPLAYED AT CONTROL HEAD

The following table lists and defines error codes for EDACS, conventional, and P25 modes. Fatal errors typically cause the radio to automatically reset after a short delay. For non-fatal errors, the radio will typically resume operation after a short delay.

Table 13-2: Error Codes

DISPLAYED CODE	MEANING
FATAL SYSTEM ERROR CODES:	
Startup Errors	
(0x0004)	Flash memory checksum test error
(0x0005)	Flash memory part is unknown
(0x0006)	FIPS random IV test error
(0x0007)	FIPS bypass test error
(0x0008)	FIPS no voice keys error
(0x0009)	Flash memory write error
Initialization Errors	
(0x0022)	I2C driver initialization error
(0x0023)	I2C driver mode change error
(0x0024)	I2C driver write error
(0x0025)	UART driver failed initialization
(0x0026)	Timer failed initialization
(0x0027)	Microwire driver failed
ADI Driver Fatal Error Codes	
(0x0030)	DSP encryption module failed to load
(0x0031)	DSP encryption module failed to unload
(0x0032)	DSP encryption module load/unload errors reported
(0x0033)	DSP encryption module failed to receive a response to load command
(0x0034)	DSP encryption module failed to receive a response to unload command
(0x0035)	DSP encryption module response contains invalid module ID
(0x0039)	FIPS DES self-test had incorrect result
LCD Driver Fatal Error Codes	
(0x0040)	LCD did not acknowledge message
(0x0041)	LCD hardware is invalid
CAN Driver Fatal Error Codes	
(0x0060)	CAN server semaphore initialization failure
IPC DSP Driver Fatal Error Codes	
(0x0070)	DSP did not read a message within 500 milliseconds
(0x0071)	DSP gave a response longer than buffer
(0x0072)	The DSP D-Channel did not read the stream data within 500ms
(0x0073)	A single D-Channel DSP message contains more data than the ARM could store.
(0x0074)	The ARM tried to write the DSP code and failed.
(0x0075)	The ARM did not get an ACK to a command to the DSP.
(0x0076)	The buffer between the ISR and the IPC task overflowed
(0x0077)	Data was lost between the ISR and the IPC task
(0x0078)	The ARM ISR buffer could not hold this D-Channel message
(0x0079)	Data was lost between the ISR and the IPC D-Channel task
(0x007A)	The DSP tried to write zero length D-Channel data message
(0x007B)	The ARM missed a C/R Channel DSP message

DISPLAYED CODE	MEANING
(0x007C)	The ARM missed a D-Channel DSP message
Radio Driver Fatal Error Codes	
(0x0080)	Transceiver failed to program the PLL after N retries due to uwire collision.
(0x0081)	Transceiver failed to program the MCU after N retries.
(0x0082)	Transceiver failed to find the proper calibration data for the radio.
(0x0083)	Transceiver MCU failed to program the RX ADC after N retries.
(0x0084)	The Transceiver Excalibur Rx ADC calibration failed to complete.
(0x0085)	The Transceiver failed to reset the MCU after N retries.
(0x0086)	The SPI sequence aborted and the XCVR failed to configure the RF hardware.
(0x0087)	The Transceiver is in an unknown state.
(0x0088)	The RFLSI message retried out.
(0x0089)	The RFLSI did not come out of the discovery phase.
(0x008a)	The RFLSI missed a bunch of heartbeats.
(0x008b)	AFE did not tune correctly.
MCBSP Fatal Error Codes	
(0x0093)	McBSP configuration error
RF Parameter driver fatal error codes	
(0x00A0)	The RFPARAM CM Table not initialized.
(0x00A1)	The RFPARAM Preselector Table not initialized.
(0x00A2)	The RFPARAM TCXO Table not initialized.
(0x00A3)	The RFPARAM RSSI Table not initialized.
PA Parameter driver fatal error codes	
(0x00B0)	The PAPARAM CM Table not initialized.
(0x00B1)	The PAPARAM TGC Table not initialized.
(0x00B2)	The PAPARAM TX BIAS Table not initialized.
Operating System Fatal Error Codes	
(0x0100)	There was an interrupt that had no handler.
(0x0101)	Prefetch abort handler.
(0x0102)	There was a data abort.
(0x0103)	There was a reserved interrupt.
(0x0104)	There was an unexpected interrupt.
(0x0105)	The interrupt handler failed to set up the IRQ.
(0x0106)	The OS fork creation/execution process failed.
(0x0107)	The OS pipe creation/use process failed.
(0x0108)	The OS task creation/use process failed.
(0x0109)	Task stack overflowed
(0x0110)	OS timer task creation failed
(0x0111)	OS returned fatal error
(0x0112)	OS fork stack overflowed
(0x0113)	OS priority fork stack overflowed
(0x0114)	GPIO config was wrong - check radio config
(0x0115)	MPUIO config was wrong - check radio config
(0x0116)	Could not set radio type right using sector 0
(0x0117)	Failure in download system
(0x0118)	Memory allocation failed
(0x0119)	Semaphore pending error
(0x0120)	Semaphore post operation error
(0x0121)	OS fork stack had nucleus error

DISPLAYED CODE	MEANING
(0x0122)	OS priority fork stack had nucleus error
(0x0123)	The data stack overflowed.
(0x0124)	The protocol stack overflowed.
(0x0125)	The RI stack overflowed.
(0x0126)	The UI stack overflowed.
(0x0127)	The watchdog stack overflowed.
(0x0128)	The MAINT stack overflowed.
(0x0129)	The HDT stack overflowed.
(0x0130)	The CAN stack overflowed.
(0x0131)	The IPC stack overflowed.
(0x0132)	The MCU stack overflowed.
(0x0133)	The startup stack overflowed.
(0x0134)	The programmer/bootloader stack overflowed.
(0x0135)	The Bluetooth stack overflowed.
(0x0136)	The I/O stream handler died.
(0x0137)	The string for the log store was too long.
(0x0138)	A semaphore post operation went badly wrong.
(0x0139)	an array or switch index was out of range.
(0x0140)	The internet Low Bitrate Codec (iLBC) stack overflowed.
FATAL APPLICATION ERROR CODES:	
Protocol Stack Error Codes	
(0x1210)	EDACS/EA stack main state was corrupted.
(0x1211)	P25T stack main state was corrupted.
(0x1212)	Conventional stack main state was corrupted.
(0x1213)	Bluetooth stack received a bad message.
Test unit fatal sys error codes	
(0x1303)	CISYS message buffer not enabled.
Conventional Fatal System Error Codes	
(0x1400)	Error calling RADC function
(0x3401)	Synthesizer became unlocked
(0x1402)	UI message buffer not enabled
(0x1408)	Error calling RADC function in ECP1 scan
(0x1450)	Error calling RADC function in CONVTX - idle mode
(0x1451)	Invalid TX Block Type was set in P25C
(0x1452)	Error calling RADC function in trunked P25
(0x1453)	Error reading serial number
(0x1454)	Bad message type requested
(0x1455)	Bad registration type requested
(0x1456)	Bad registration type on returning with P25_REG_COMPLETE action
(0x1457)	Bad activation type requested
(0x1458)	Radio did not get a RAMPDOWN from the DSP through a bunch of retries
(0x1460)	Bad state called for the KMM Handler state machine
(0x1461)	Bad state within custom scan restore home
(0x1462)	Invalid data Rx queue index detected
(0x1463)	Invalid crypto state / action requested
Personality Interface Fatal System Error Codes	
(0x5500)	Personality data is not present
(0x5501)	Flash personality Cyclic Redundancy Check (CRC) did not match EEPROM's CRC

DISPLAYED CODE	MEANING
(0x5502)	Personality descriptor table CRC error.
(0x1503)	Descriptor table memory error.
(0x5504)	Custom frequency set table error.
(0x5505)	Personality store identifier is not present.
(0x5508)	The variable personality write to flash conversion failed.
(0x5509)	Increased Personality files are not present.
(0x5510)	Enhanced Personality Write Failure.
User Interface Fatal System Error Codes	
(0x5600)	Input/Output device error
(0x1601)	Out of memory
(0x1602)	Maximum number of timers exceeded
(0x1603)	Too many open windows
(0x1604)	Out of memory
(0x1605)	Invalid parameter
(0x1606)	RI BBOS message buffer full error
(0x1607)	RI System (EDACSBBOS message buffer full error)
(0x1608)	CI BBOS message buffer full error
(0x1609)	I/O device type (from personality) not supported
(0x1614)	UI I/O message buffer full error
(0x1615)	malloc() returned no more memory
(0x1616)	No more memory
(0x1617)	malloc() returned no more memory
Test Unit Fatal System Error Codes	
(0x1706)	The test unit could not write serial data out.
Enhanced Keyload Fatal System Error Codes	
(0x1804)	A general keyload error has occurred.
FIPS 140 Fatal System Error Codes	
(0x1902)	Invalid DESMAC key.
(0x1903)	DESMAC checksum failed.
(0x1904)	DESMAC DSP attach failed.
(0x1905)	BAD MSGID passed internally.
(0x1A00)	Bad calibration data type requested.
NON-FATAL APPLICATION ERROR CODES:	
Common Error Messages	
(0)	"UNKNOWN " Calling error
(1)	"FEAT DAT" Feature encryption error message.
(2)	"NO TRACK" Tracking data was bad.
(3)	"PERSNLTY" Personality recoverable error message.
(4)	"G-STAR" GSTAR Error.
(5)	"TONE ENC" Tone Encode Error.
(6)	"VOC CNFG" Vocoder configuration error.
(7)	"DSP ENCR" Flash DSP encryption module CRC Error.
(8)	"NC ERROR" Noise Cancellation Error.
(9)	MDC Error.
(10)	Wideband Error.
(11)	"TSBK RSP" TSBK on Analog Error.
(12)	"NO VRB" Error displayed when VRB is not available.

DISPLAYED CODE	MEANING
Flags for error handling and display	
(0x8000)	If this bit is OR'd with the error number, the user must clear the error (no timeout).
(0x0FFF)	Flag mask to extract error code from combined code/control bits
(2000)	Fixed error message display timeout in ms.
Personality Conversion Error Codes	
(0x0100)	EE Prom read error.
(0x0101)	EE Prom write error.
(0x0102)	Invalid Argument to Function.
(0x0103)	Invalid variable personality checksum.
(0x0104)	Invalid variable personality length.
(0x0105)	Variable personality section not found.
(0x0106)	Variable personality conversion failure.
(0x0107)	Constant personality conversion failure.
(0x0108)	Descriptor table CRC failure.
(0x0109)	Descriptor table size failure.
(0x0110)	The version of RPM used to program with is too old.
(0x0150)	NULL Pointer was returned.
Feature Encryption Errors	
(0x0550)	Cannot read SROM
(0x0551)	Personalities sizes do not match
(0x0552)	Decryption failure
(0x0554)	System cannot run without PROSCAN feature enabled.
(0x0555)	WB channel cannot run with WB Disabled feature enabled.
(0x0556)	WB system cannot run with WB Disabled feature enabled.
(0x0557)	TSBK On Analog feature not enabled.
Calibration Parameter Error Codes	
(0x0560)	ECP/XGP calibration data missing; data updated to current defaults.
(0x0590)	TestApp calibration data missing; data updated.
System load/configuration error codes	
(0x0862)	Attempt to use DES encryption with the DES feature turned off.
(0x0863)	Attempt to use AES encryption with the AES feature turned off.
(0x0864)	Attempt to use DES encryption with no module available.
(0x0865)	Attempt to use AES encryption with no module available.
(0x0866)	DES encryption module loaded but bad.
(0x0867)	AES encryption module loaded but bad.
(0x0868)	Attempt to use custom encryption with no module available.
(0x0869)	AES encryption module loaded but was too old.
(0x0873)	Error loading DES module.
(0x0874)	Error loading AES module.
(0x0875)	Error loading CUST module.
(0x0876)	FIPS feature is enabled but a NON-FIPS module is loaded.
(0x0877)	Personality is set for a different encryption type than system, and mixed key is not allowed.
(0x0878)	Attempt to use ARC4 encryption with the ENC_LITE feature turned off.
(0x0881)	Voice Group is not supported by the DSP.
(0x0882)	Aegis is not supported by the DSP
(0x0883)	IMBE is not supported by DSP
(0x0891)	No G-STAR response from DSP
(0x0892)	No tone encode response from DSP

DISPLAYED CODE	MEANING
(0x0893)	No MDC response from DSP.
(0x0895)	Noise Cancellation Error.
(0x0896)	No TSBK on Analog response from DSP.
(0x0897)	VRB not available.
(0x0904)	Error reading from the PIR_CRYPT_KEY table
(0x0905)	Error reading one DES key from Digital Config table
(0x0906)	Error zeroizing ARC4 key store
(0x0907)	Error cannot load ARC4 keys because ENC_LITE feature is disabled

This page intentionally left blank.

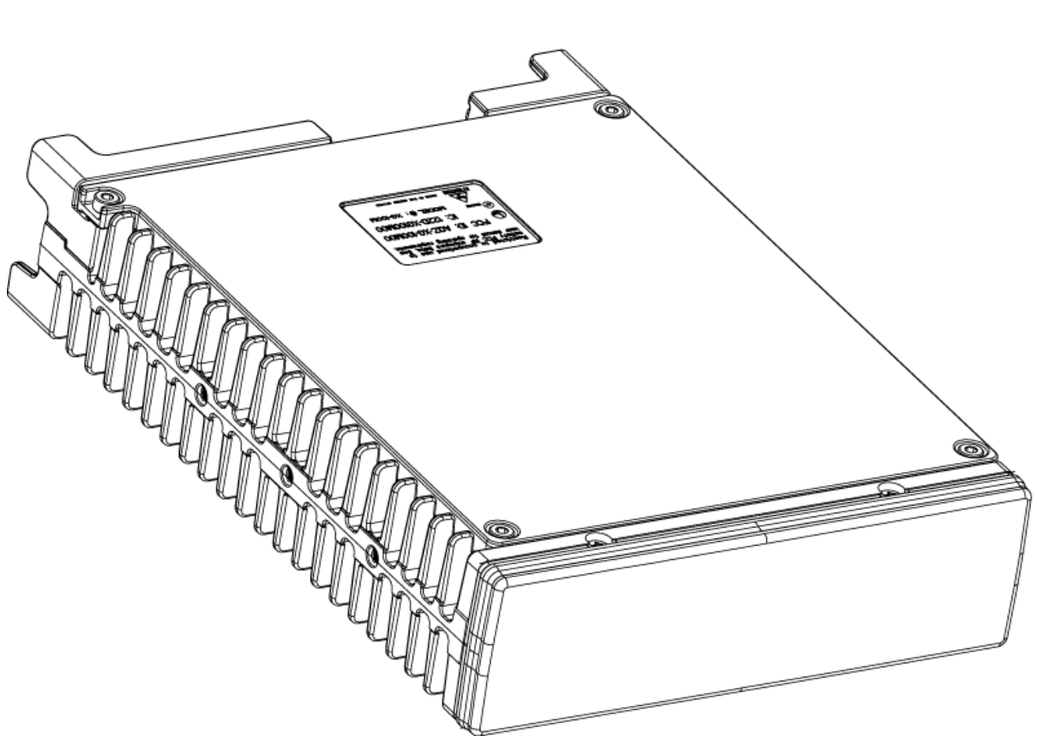
14. ASSEMBLY DIAGRAMS

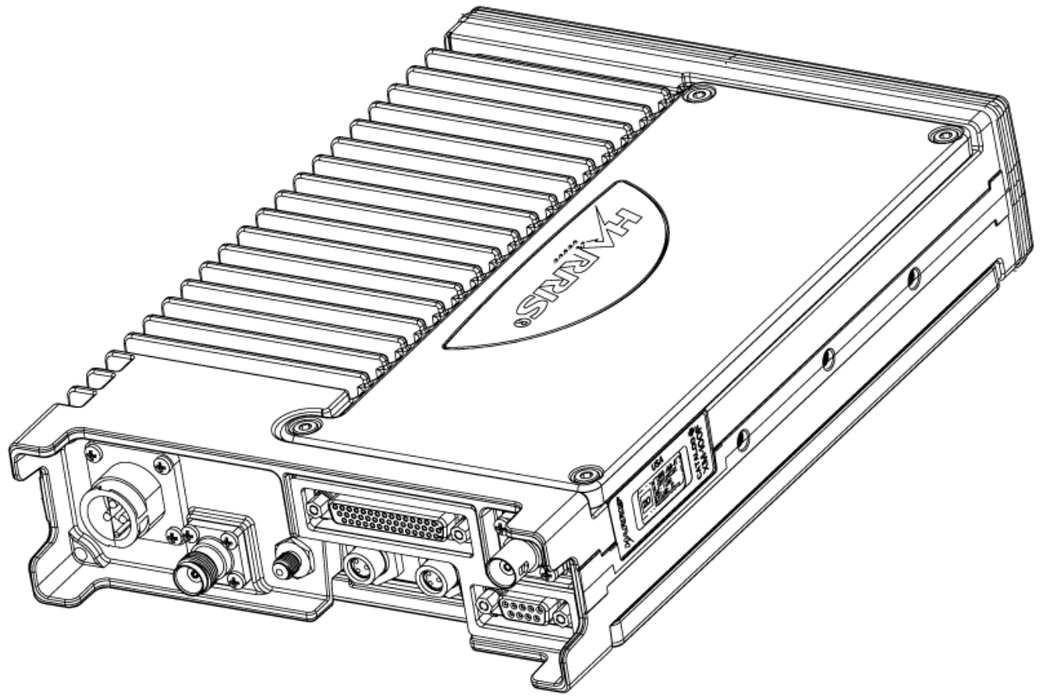
TORQUE SPECIFICATION: STATIC RE-TORQUE REQUIREMENTS AS FOLLOWS:

2.1 TORQUE SPECIFICATION 6 TO 8 IN-LB. (6.9 - 9.2 KG-CM)

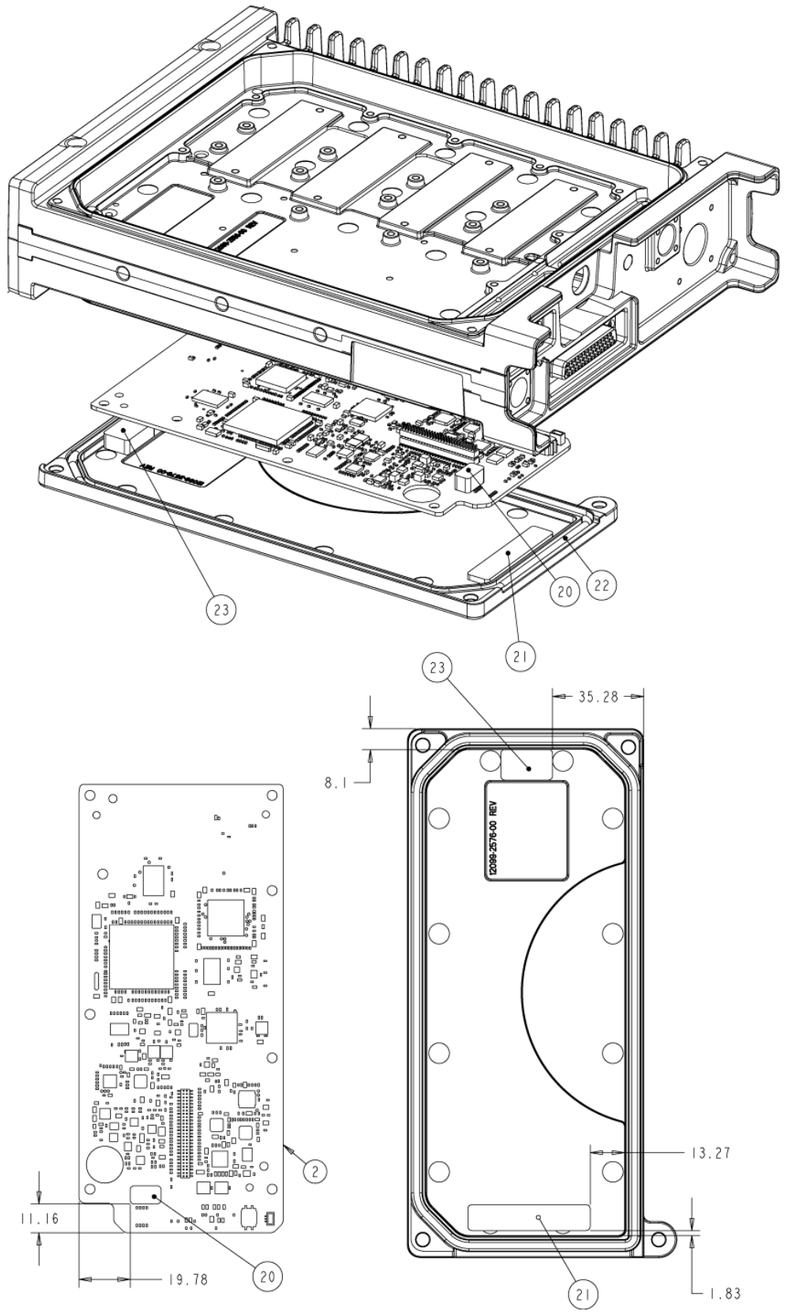
2.2 TORQUE SPECIFICATION 16 TO 18 IN-LB. (18.4 - 20.7 KG-CM)

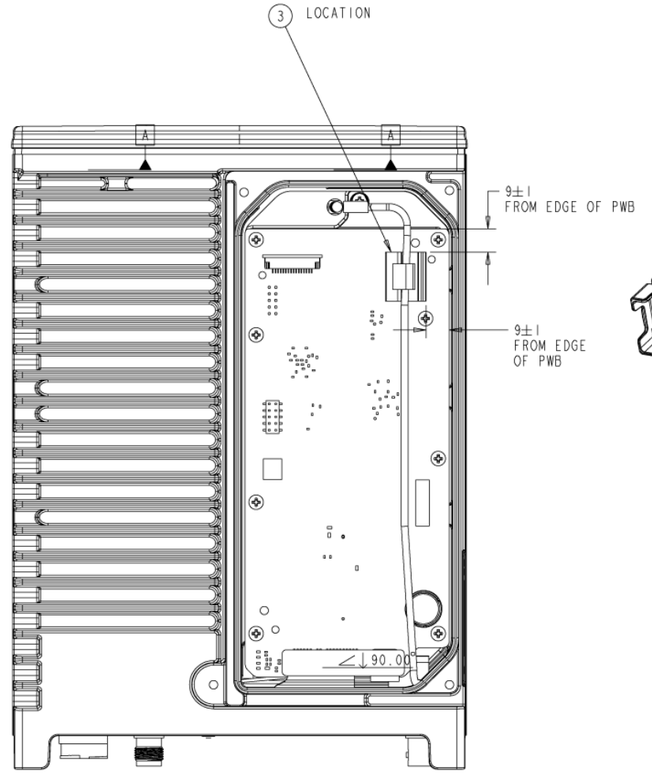
2.3 TORQUE SPECIFICATION 5 TO 7 IN-LB. (5.8 - 8.1 KG-CM)

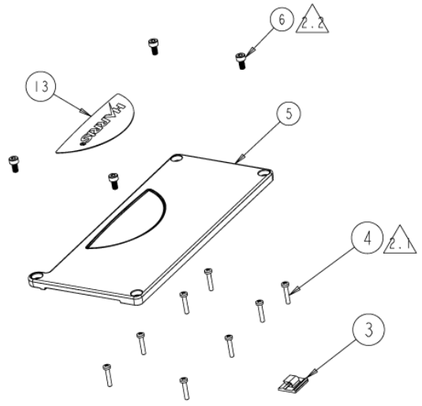


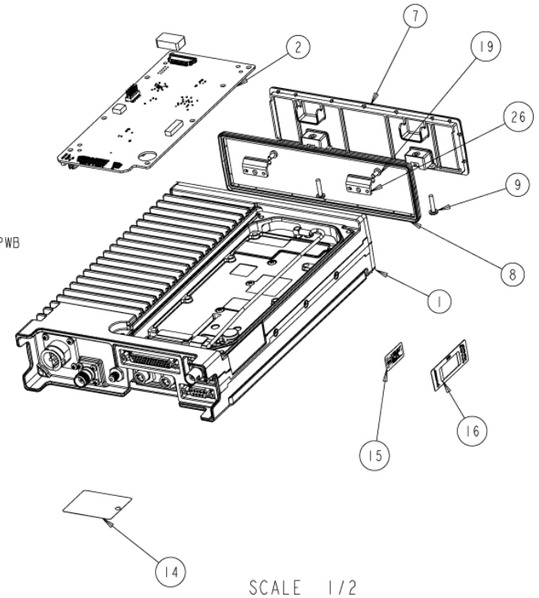


D12099-1000, Rev. D, page 1 of 2


23
21
20
22
23
35.28
8.1
12099-2576-00 REV
13.27
1.83
2
11.16
19.78
20
21


3 LOCATION
A
A
9±1
FROM EDGE OF PWB
9±1
FROM EDGE
OF PWB
90.00


6
2.2
13
5
4
2.1
3


7
2
19
26
9
8
1
16
15
14
SCALE 1/2

NOTES:
1. THE COMPLETED ASSEMBLY SHALL COMPLY WITH IPC-A-610 STANDARDS OF WORKMANSHIP
   DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5M-1994.
   UNLESS OTHERWISE SPECIFIED:
   ALL DIMENSIONS ARE IN MILLIMETERS.
   GENERAL TOLERANCE TO BE:
   X.X ± 0.3 ; X.XX ±0.13; ANGLES ±°1

2. TORQUE SPECIFICATION:

   2.1 TORQUE SPECIFICATION 2.5 TO 3.5 IN-LB. (2.9 - 4.0 KG-CM).

   2.2 TORQUE SPECIFICATION 6 TO 8 IN-LB. (6.9 - 9.2 KG-CM)

   2.3 TORQUE SPECIFICATION 16 TO 18 IN-LB. (18.4 - 20.7 KG-CM)

   2.4 TORQUE SPECIFICATION 8 TO 10 IN-1B (9.2 - 11.5 KG-CM)

   2.5 TORQUE SPECIFICATION 29 TO 31 IN-LB (33.4 - 35.7 KG-CM)

3. FIRST ARTICLE :
   FIRST ARTICLE SAMPLES FOR EACH VERSION ARE TO BE
   PROVIDED BY THE VENDOR AND APPROVED IN WRITING BY HARRIS\RF
   COMMUNICATIONS ENGINEERING AND MATERIAL QUALITY CONTROL DEPARTMENTS.
   FIRST ARTICLES AND ALL SUPPORTING DOCUMENTATION (REPORTS, APPROVALS,
   LAYOUTS, ECT.) OF EACH VERSION SHALL BE RETAINED FOR FUTURE REFERENCE.
   THESE SAMPLES WILL ACT TO ANSWER ANY INFORMATION NOT PROVIDED IN THE
   DRAWING OR THE ELECTRONIC FILE.

4. INSTALL ITEM 7 (M3 SCREW) INTO ITEM A1 HOLE AND SLOT FEATURES SHOWN ON DETAIL A
   PRIOR TO INSTALLATION OF OTHER FASTENERS.

5. ITEM 18 HARDWARE:
   EXTRA HARDWARE SHALL BE DISCARDED.

6. APPLY ITEMS 20 & 28 ALL AROUND THREADS ON ITEM 18 PRIOR TO INSTALLATION .

7. CLEAN MOUNTING SURFACES ON ITEM 1 WITH PREFERRED METHOD OF 50:50 MIX OF ISOPROPYL ALCOHOL
   AND DISTILLED WATER PRIOR TO INSTALLING ITEMS 19 & 21. ALTERNATIVE METHOD PER HARRIS MANUFACTURING
   ASSEMBLY PROCESS IS ACCEPTABLE.

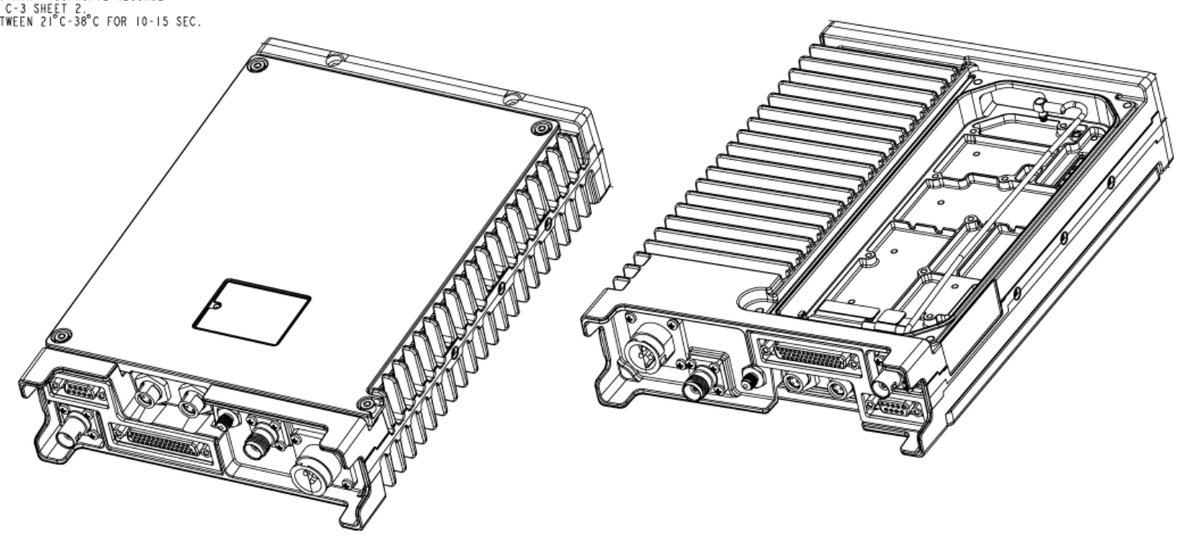
8. APPLY ITEM 27 ON ITEM 1 SURFACES PRIOR TO INSTALLING ITEMS U15, U57, U22 AND U23.

9. D-SUB SEAL (ITEM 8): CLEAN MATING SURACE OF THE HOUSING (ITEM 1) WITH PREFERRED METHOD OF 50:50 MIX ISOPROPYL ALCOHOL
   AND DISTILLED WATER. REMOVE BOTTOM BACKER FROM ITEM 8 AND INSTALL INTO ITEM 1 AS SHOWN ON LOC C-3 SHEET 2.
   ACTIVATE ADHESIVE WITH ASSEMBLY FIXTURE UNDER FIRM PRESSURE 200kPa (29 psi) AT TEMERATURES BETWEEN 21°C-38°C FOR 10-15 SEC.
   ALTERNATIVE METHOD PER HARRIS MANUFACTURING ASSEMBLY PROCESS IS ACCEPTABLE.

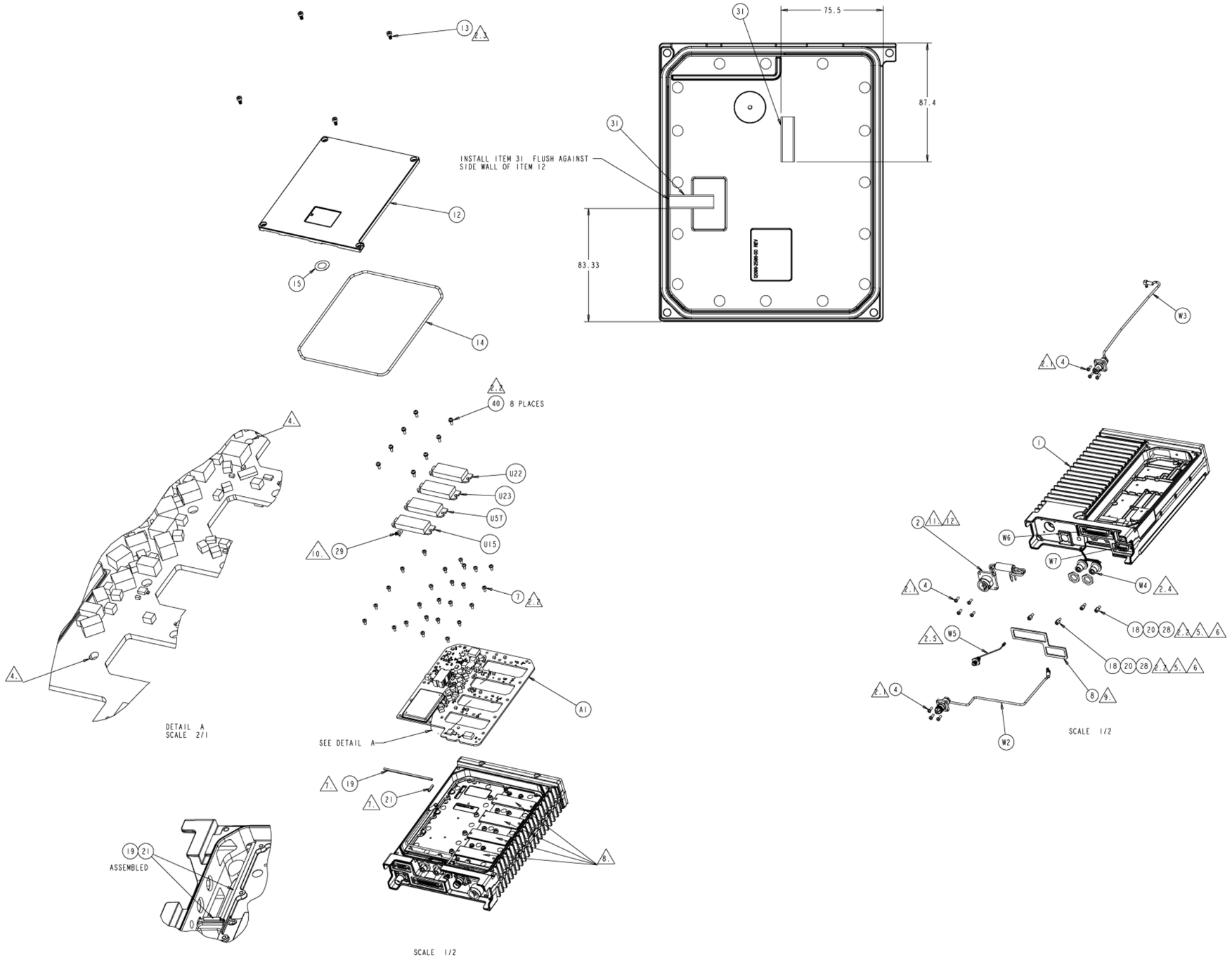
10. INSTALL ITEM 29 (GROUND CLIP) AFTER INSTALLING ITEM U15.

11. ITEM 2 TO BE SOLDERED TO ITEM A1 PER SCHEMATIC DRAWING AFTER INSTALLATION INTO ITEM 1

12. ADD ITEM 32 TO ITEM 2 O-RING TO TACK IN PLACE PRIOR TO INSTALLATION INTO ITEM 1.



D12099-3000, Rev. L, page1 of 2



D12099-3000, Rev. L, page 2 of 2

This page intentionally left blank.

About L3Harris Technologies

L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. The company provides advanced defense and commercial technologies across air, land, sea, space and cyber domains.